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Improved Grinding and Polishing Machinery.

In our issue of Nov. 21, 1889, we illustrated in detail an improved journal bearing especially adapted to the class of grinding and polishing machinery which is illustrated by the engravings on this page. In this journal, as will be remembered, the boxes practically rest upon stiff spiral springs which allow them to take a slight motion when the machine is running, and thus the advantages of a yielding bearing are secured, while at the same time things are so arranged that, by the simple movement of a small hand lever under each box, the parts are brought down to a solid bearing which is unyielding, the change from one kind of bearing to the other being instantly made as the requirements of the work may demand.

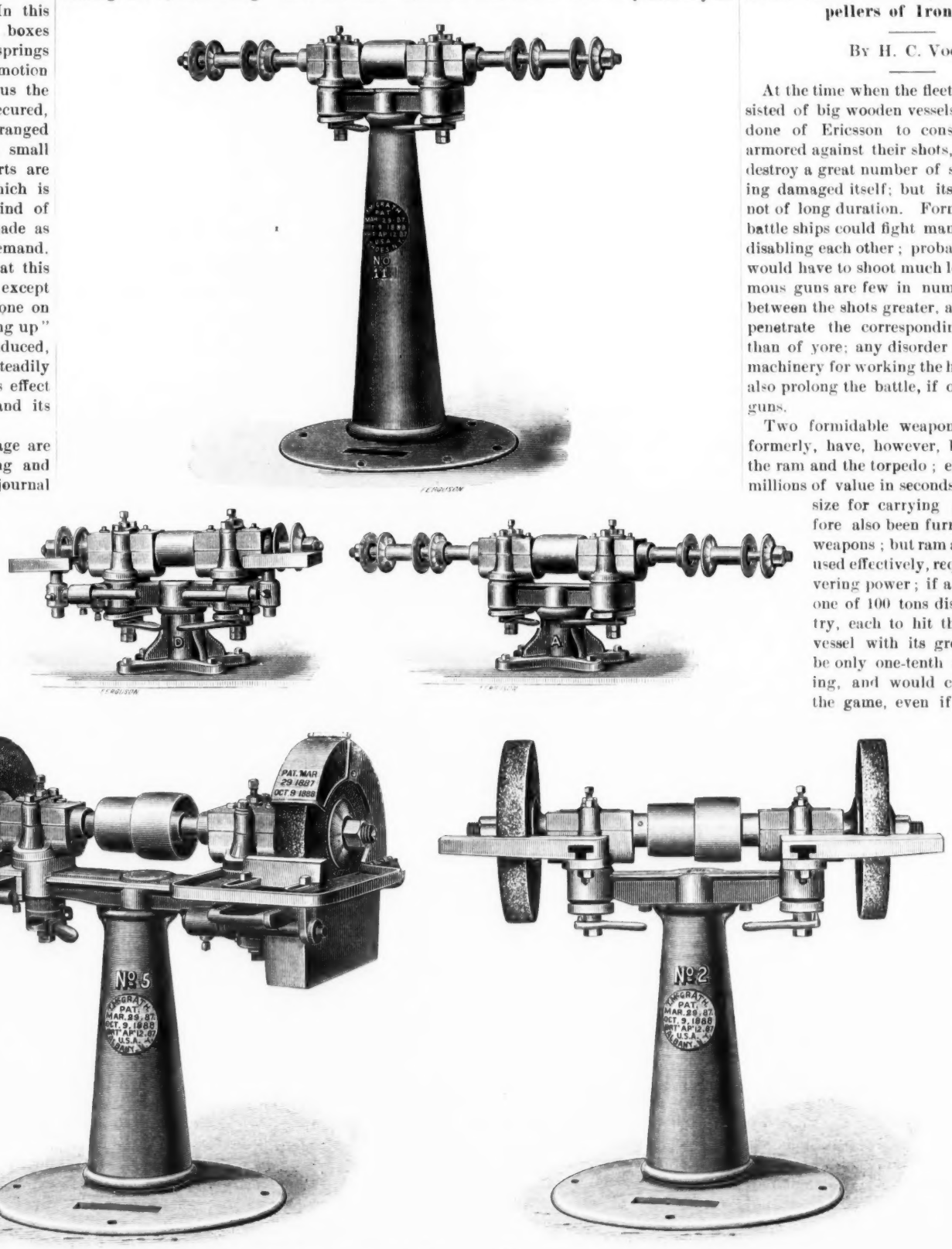
It is unnecessary to call attention at this time to the advantages of this plan, except to say that, for the kind of work done on such machines, the amount of "truing up" required by the wheels is very much reduced, and the machines run much more steadily and smoothly, which of course has its effect upon the quality of the work done, and its cost.

The engravings shown on this page are representative of the class of grinding and polishing machinery to which these journal bearings have been applied with good results. Machine No. 11 is adapted to the finest kinds of work, such as jewelry, nickel-plate, silver ware, britannia, watch cases, etc., requiring the highest rate of speed. It is adapted to carry four wheels, and a taper attachment is provided which screws into the end of the spindle. The spindle is of steel, $1\frac{7}{16}$ inches diameter, and 46 inches long, with bearings 6 inches long, self-oiling and dust protected. The weight of the machine is 215 pounds. The "A" machine is a duplicate of this, except that it is designed to stand on a bench. Its weight is 135 pounds.

The "D" machine is a bench grinder, and is adapted to all kinds of light grinding, such as is usually done in machine shops and mills, for grinding tools, knives of wood-working machines, etc. For this purpose it is provided with adjustable rests as shown. It can be placed, if desired, upon a column which may be of any height from 10 inches to 36 inches. The diameter of spindle and length of boxes are the same as in the previously described machines.

The No. 2 machine is intended for any kind of heavy grinding. There are four heavy springs under each bearing, the rests are very heavy, and attached to the machine in a very substantial manner to secure the greatest possible steadiness, and the journal bearings are $7\frac{1}{2}$ inches long. Like the other machines, it has self-oiling and dust-protected journals. Its weight is 420 pounds.

In the construction of the journals, etc., the No. 5 machine is the same as the others, but it has in addition an attachment for wet grinding at one side, while the other wheel is available for dry grinding. The wet wheel is enclosed in a hood to prevent the flying of water, which is contained in the tank underneath; this tank being raised when it is desired to apply water to the wheel by pushing in the handle shown underneath the rest in front of the machine. This handle is attached to what is practically an inclined plane or wedge, which, when pushed in, raises the tank so that the wheel is partly immersed in the water. Drawing out the handle lets the tank down, so that the wheel does not reach the water. This attachment can readily be removed when it is desired to use both ends of the machine for ordinary dry grinding. This machine weighs 508 pounds. Other styles of machines are constructed, having various arrangements of wheels, rests, etc., by McGrath & Collins, Cohoes, N. Y.



IMPROVED POLISHING AND GRINDING MACHINERY.

Small Sword Vessels, to Destroy Propellers of Ironclads.

BY H. C. VOGT.

At the time when the fleets of nations consisted of big wooden vessels, it was cleverly done of Ericsson to construct a monitor armored against their shots, and thus able to destroy a great number of ships without being damaged itself; but its superiority was not of long duration. Formerly two line-of-battle ships could fight many hours without disabling each other; probably two ironclads would have to shoot much longer; their enormous guns are few in number, the interval between the shots greater, and the power to penetrate the corresponding walls smaller than of yore; any disorder in the intricate machinery for working the heavy guns would also prolong the battle, if only fought with guns.

Two formidable weapons, not in vogue formerly, have, however, been introduced; the ram and the torpedo; either may destroy millions of value in seconds. Ships of great size for carrying guns have therefore also been furnished with these weapons; but ram and torpedo, to be used effectively, require high maneuvering power; if a ship of 1,000 and one of 100 tons displacement are to try, each to hit the other, the big vessel with its great inertia might be only one-tenth as quick in turning, and would consequently lose the game, even if it possessed the same speed. A ship carrying neither guns nor heavy side armor can use the whole buoyancy of its displacement to increase the power of its machinery, and the strength of its ram and hull; every bit of weight that is otherwise used must deduct from what it is more essential to develop.

Small sword ships, to destroy propellers, should be protected by means of wooden armor, from the projectiles of quick-firing guns. (See the section, Fig. 2 page 2.) Heavy guns, requiring several minutes to be adjusted and aimed accurately, would scarcely be dangerous for small craft with great speed. Fig. 1 represents a sword ship of about 110 tons displacement, intended for wrecking shafts or propeller

blades of middle-sized ironclads or armored cruisers; its sword S is over 10 feet long, and cut like a saw to prevent sliding; its upper point p is 6 feet, while its lower point q is 11.5 feet under the water level. A sword vessel of 200 tons displacement would have the lower point of its sword nearly 16 feet under the water level.

The sword S is carried and supported by the two arms A and A_1, which should not be thicker than necessary for the sake of not impeding the maneuvering power. Already at a speed of 6 knots the energy stored in the said floating sword S is about 200 foot-tons, and as this energy increases with the square of the speed, it is not difficult to furnish the sword S with the same energy as that of a projectile from a 30-ton gun, close to the muzzle. Sometimes a big piece of ice is sufficient to spoil a propeller.

When, farther, the sword is 10 or 12 feet in a vertical direction, and the outside part of the propeller and shaft of the ironclad is 35 feet in a horizontal direction, an able sailor should not have much difficulty in hitting the propelling apparatus. Sword ships should be furnished with twin propellers, with a balanced rudder between them, and fitted up with many water-tight compartments, some of which should be filled with water when going into action, for the sake of lowering the ship. The speed ought to be higher than that of torpedo boats of equal power and displacement, because the sword ship has no large upper works to sustain, so that the immersed part can obtain better lines for speed. The conning towers T and t should be armored against quick-firing guns, and stuffed inside, to mitigate shocks from collision. Although any kind of propellers might be used, the maneuvering power is especially improved with the two-bladed propellers shown in Fig. 3. The blades B are connected by means of a blade axle a, which can turn freely in the box O. The pressure on the respective blades, which ordinarily differs very much in the currents of different velocities following the ship, will by this arrangement be equalized. The thrust of the upper blade is greatest in ordinary propellers, on account of the greater speed of the upper wake; but here its pitch angle decreases a little, while the pitch of the opposite blade increases just as much, until the pressures are balanced. Vibrations are totally avoided, and when the ship turns, the blade which at the moment goes against the direction of turning of the stern, yields, reducing its pitch and resistance to the turning, while the increase in pitch of the opposite blade is just as much, thus facilitating the turning. A matter of considerable importance is also that, when the engine is reversed, the blade axle with the blades turns 180° immediately, to be in a new state of equilibrium when the propeller revolves the opposite way; it is thus as effective in driving astern as ahead. This propeller should, of course, be of the best forged iron or steel, and the blade axle should be perfectly loose in the box O, because the moment of gyration of the propeller, together with the friction on the blade axle, keeps it quite steady. Experiments prove that it is not possible altogether to reduce the supremacy of the upper blade under speed, but the maneuvering power is nevertheless enormously increased; the speed is also augmented a little, and the engine works more economically.

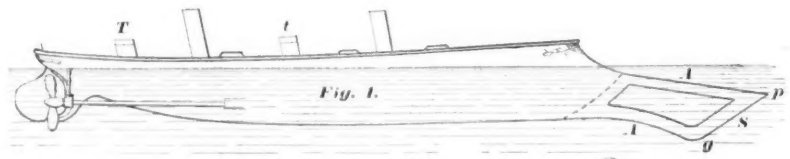
A problem connected with this, but in many cases of the highest importance, is how the ship may be adapted to its commander. Everything tending to reduce his intellectual energy in time of action should be avoided. The thoughts, although invisible, are nevertheless able to govern the action of the brain, nerves, etc.; but the energy for this action is restored from the body, and is consequently limited and divisible; so when several things must be thought of simultaneously the energy at disposal must be divided between them. For example: If a man had to dictate lessons on mathematics, music and metaphysics in the same hour, his intellectual energy to be bestowed on each must be lowered, because sudden changes in the inertia of the brain motions cause loss of energy. It is therefore better to treat each of these sciences separately, or to have a man for each; this is no doubt generally acknowledged, but still, very little objection is raised against letting a commander of an ironclad direct maneuvers for ram, guns, torpedoes, notice courses, signals, electric lights, and conduct correspondence concerning intricate machinery, etc., all at the same time. His intellectual energy must be divided and diminished, which is very depressing for a hero, who, when his thoughts are entangled and hampered thus, will also lose his animation and enthusiasm. In a ship properly arranged for this purpose, the intellectual energy of the commander can be concentrated. The time of action, which must be a time of enthusiasm, is not the best suited to ponder over intricate machinery, difficulties with electric currents, etc., following the influence of battle enthusiasm, it must be inspiring to strike with a sword; even if it is a big floating sword endowed with the same energy as a shot from a big gun.

It agrees with sound reason that, when an ironclad embodies some very strong and also some exceedingly delicate structures, then, in case of war, the delicate parts, which accidentally are the most important, should be destroyed. The armored upper works of an ironclad (although they weaken the ship) are very strong against war attacks; *let them therefore remain as they are;* do not lose shots and gunpowder at all upon them; the view of them irritates a sailor. The bottom of an ironclad is proportionally excessively weak, propellers and shafts still more so, and can unfortunately not be protected unless by destroying the speed of the ship; *these parts should therefore be attacked,* and the interesting play between big walls and big guns given up; at least, the sailors ought not to suffer on account of the zeal for this expensive sport between the engineers.

The maneuvering of a small sword vessel requires only one quality of the commander, namely, that he should be a sailor, nothing else. All complications to take away intellectual energy from where it is most desired are avoided; sitting in the conning tower T, the commander is able to concentrate his whole attention upon the maneuvers required to rush upon and destroy propellers; a lookout should be kept from the other tower t. Within a distance of 1,000 feet from an ironclad, big shots striking the deck of a sword vessel ricochets, and as the said distance should be passed in 25 seconds, the chance of being damaged is little, when protected against quick-firing guns. Suppose an ironclad and a sword vessel going, say, 15 and 24 knots respectively, the sword vessel possessing ten times greater maneuvering power; its commander requires then only to thrust his floating sword within the disk area of the condemned propeller, when all its blades are cut off in a moment; in fact, propellers or shafts cannot avoid being destroyed when hit with a floating sword, which strikes somewhat harder than a lump of ice.

The proper course to follow, if an ironclad, say, of 14,000 tons, approaches a seaport is, consequently, as soon as possible to send a couple of sword vessels to destroy both its propellers. There can be little doubt concerning the correctness of this method, because complicated torpedoes often fail at the decisive moment, whereas a sword must damage where it hits; secondly, the maneuvers demanded for the application of torpedoes are always impeded by a great number of difficulties; one cannot rush with full force against the enemy, and strike as with a sword.

It is generally acknowledged that, when the appearance of a construction is very displeasing, something must be wrong; now all sailors agree in abhorring ironclads, on account of their total disagreement with the talents and dispositions of sailors; it has also often and correctly been noticed that sailorship was not needed to the same extent as formerly, but is it not a mistake to give a sailor a weapon, the use of which does not first of all require the very best of his qualities? *In the days of the naval heroes there were no complications about a ship which the commander did not thoroughly understand, and consequently no dissipation or diversion of intellectual energy.* A sailor hero commanding an ironclad would probably trust solely to his maneuvers, and use his vessel as a ram, wishing all its complications to the devil; such has actually been the case in a well-known sea battle. No doubt it is a better philosophy to adapt vessels for sailors, instead of spoiling sailors for the sake of a kind of ungraceful floating complication, which does not first of all require sailorship to be used, and which expose enormous values of life and property to be ruined in a very short time.



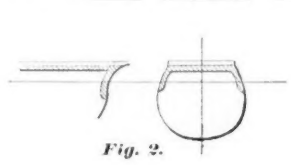


Fig. 2.

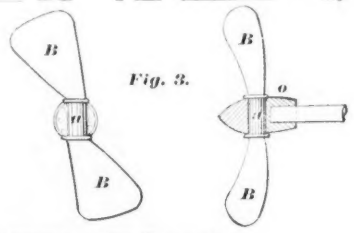


Fig. 3.

SMALL SWORD VESSELS.—SEE PAGE 1.

Polishing Frame.

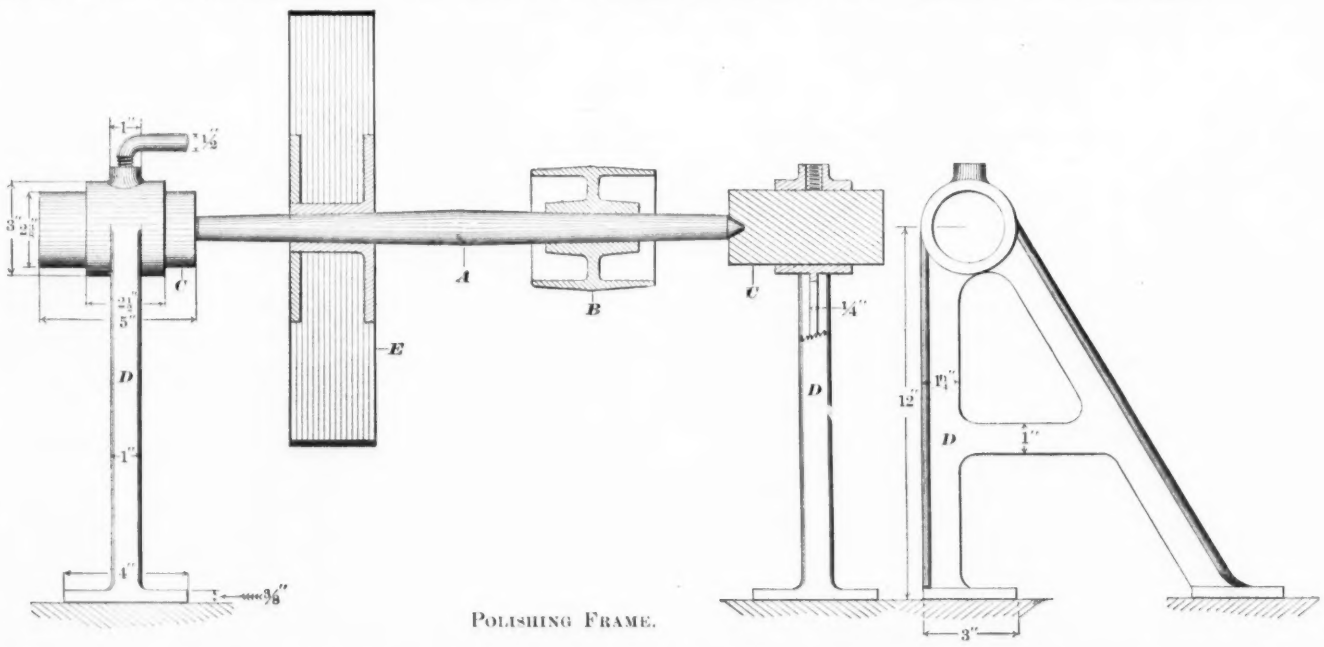
BY F. H. TREACY.

By means of the accompanying drawing, and a brief explanation, the writer hopes to make clear to those who are not familiar with it, an old (in fact, one of the oldest) device in use for polishing, and one which seems to possess many good points. The principal dimensions are given on the drawing for the standards D D, which are cast-iron. The blocks C C are made of hard wood, and receive the spindle A, the ends of which are pointed. Three or more centers made in the ends of the blocks, and each a different distance from the center of the block, will provide a means by which the belt can be tightened by simply revolving the block C, and fastening with the set-screw shown on D.

The spindle A should be made of steel, and both ends hardened. The dimensions being: Largest diameter, $1\frac{1}{8}''$; smallest, each end, $1\frac{3}{16}''$; angle of points, 60°; total length, 18″.

The standards D D should be firmly bolted to the floor on two pieces of 2x4, which have been placed parallel to the spindle A.

The driving or countershaft is also placed on the floor at a convenient distance back of the frame.



POLISHING FRAME.

A pair of ordinary overhead hangers can be inverted, and the boxes reversed to carry the countershaft.

With a speed of 300 revolutions, and an 18 inch pulley for a driver, and a four inch pulley on the spindle, sufficient speed will be obtained for the large wheels, and smaller pulleys can be used on the spindle for the higher speeds required by the small wheels.

The belt should be $3\frac{1}{2}''$ wide to give good results.

I believe the majority of machinery users are becoming aware of the fact that narrow belts laced up to concert pitch exert some of their power in a manner which has failed thus far to expand the dividend with all the extra friction, and even heat they have produced. In another article I will show a spindle for solid emery wheels adapted to this frame, also the details of making wooden buffs and polishing wheels.

A Providence (R. I.) dispatch says: "Last night, as the warps ran out, the carding and spinning departments of the Harrison Woolen-mill, at Woonsocket, shut down. There is every prospect of a complete shut-down of the mills belonging to this company in Woonsocket."

Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

SEVENTEENTH PAPER.

163.—THE BEVEL GEAR CHART.

The drafting of the bevel gear blanks by means of the method of (162) is simple, but the method requires drafting instruments, not always at hand, as well as the ability to use them accurately. The drawing must be carefully made, to give correct results, particularly when the gears are small. After the drawing is made the various angles and diameters must be taken off for use at the lathe, and that is by no means a simple matter.

So great are the practical difficulties that any one who has a knowledge of simple arithmetic will find it not only easier, but more accurate to use the chart and method by means of the following rules.

164.—SHAFTS AT RIGHT ANGLES.

1st.—Divide the pitch diameter by that of the other gear of the pair, or else the number of teeth by that of the other gear, to get the proportion.

Enter the table by means of the proportion. All numbers for that pair will be found on the same horizontal line in the two columns.

2d.—The center angles are given directly by the table at the proper proportion.

3d.—Divide the tabular angle increment by the number of teeth in the gear, to get the angle increment. This need be done for but one gear of a pair, as the increment is the same for both.

4th.—Add the angle increment to the center angle, to get the face angle.

5th.—Increase the angle increment by one-sixth of itself, to get the cutting decrement, and subtract this decrement from the center angle, to get the cutting angle.

6th.—Divide the tabular diameter increment by the diametral pitch, to get the diameter increment, and add that to the pitch diameter, to get the outside diameter.

Pitch = 3	Prop. = 7 — 5	Shaft ang. 90
Teeth = 42) 93 (2.22 = face incr.		
84	.37 + 1/8	
90	2.59 = cut decr.	
84		
60		
Center angles = 54.47		35.38
+ incr. 2.22		2.22
Face angles ... 56.69		37.60
Center angles = 54.47		35.38
— decr 2.59		2.59
Cut angles 51.88		32.79
Pitch = 3) 1.16		3) 1.63
Diam. incr. = .39		.54
+ p. diams. = 14.		10.
o. diams. = 14.39		10.54

SAMPLE CHART COMPUTATION, FIG. 148.

Pitch = 5	Prop. = ×	Shaft ang. 52.8
Teeth = 20) 66 (3.30 = face incr.		
	.55 + 1/8	
	3.85 = cut decr.	
Center angles = 35.80		17.00
+ incr. 3.30		3.30
Face angles = 39.10		20.30
Center angles = 35.80		17.00
— decr. 3.85		3.85
Cut angles = 31.95		13.15
Pitch = 5) 1.66		5) 1.91
Diam. incr. ..... .33		.38
+ p. diams. .... 4.		2.
o. diams. 4.33		2.38

SAMPLE CHART COMPUTATION, FIG. 149.

Fig. 148 is a sample computation for shafts at right angles.

165.—SHAFTS NOT AT RIGHT ANGLES.

The table cannot be entered by means of the proportion, and the numbers for the two gears of the pair will not be found on the same horizontal line, and it will be necessary to determine the center angles.

As in Fig. 147, draw the axes, at the given shaft angle, and find the center angles, by the method described in (162).

Then enter the table, for each gear by itself, by means of the center angles, and proceed as for shafts at right angles. The angle increment and decrement is the same for both gears of a pair.

Fig. 149 is a sample computation applied to the case of Fig. 147, the center angles being found by means of the table of chords. If preferred, the center angles can be found by means of the formula,

$$tan.\ C = \frac{sin.\ S}{\frac{1}{P} + cos.\ S}$$

in which C is the center angle of the gear, P is the proportion found by dividing the number of the teeth in the gear by the number in the other gear, and S is the shaft angle. Having found one center angle, subtract it from the shaft angle to get the other center angle.

THE BEVEL GEAR CHART.

Shafts at 90° Proportion.		Center Angle.	Angle Incr. / Div. by Teeth	Diam. Incr. / Div. by P.	Shafts at 90° Proportion.		Center Angle.	Angle Incr. / Div. by Teeth	Diam. Incr. / Div. by P.
.10	1—10	5.71	11	2.00	10.00	10—1	84.29	114	.20
.11	1— 9	6.28	13	2 00	9.00	9—1	83.66	114	.22
.13	1— 8	7.41	14	1 99	8.00	8—1	82.87	113	.25
.14	1— 7	7.97	16	1.98	7.00	7—1	81.87	113	.28
.17	1— 6	9.65	19	1.97	6.00	6—1	80.54	113	.33
.20	1— 5	11.31	23	1 96	5.00	5—1	78.69	112	.39
.22	2— 9	12 40	25	1.95	4 50	9—2	77.47	111	.43
25	1— 4	14.04	28	1 94	4.00	4—1	75 97	111	.49
.29	2— 7	16.17	32	1 92	3 50	7—2	74.06	110	.55
.30	3—10	16.70	33	1.92	3.33	10—3	73 28	109	.58
.33	1— 3	18 20	36	1.90	3 00	3—1	71.57	109	.63
.38	3— 8	20.80	40	1.87	2 67	8—3	69.47	107	.70
.40	2— 5	21.80	43	1 86	2.50	5—2	68.19	106	.74
.43	3— 7	23.27	45	1.84	2.33	7—3	66.78	105	.79
.44	4— 9	23.75	46	1.83	2.25	9—4	66.04	104	.81
.50	1— 2	26.57	51	1 79	2.00	2—1	63.44	103	.89
.56	5— 9	29.25	56	1.74	1.80	9—5	60.95	101	.97
.57	4— 7	29.67	57	1.74	1.75	7—4	60.25	99	.99
.60	3— 5	30.97	59	1 72	1.67	5—3	59.08	98	1.03
.63	5— 8	32.20	61	1.69	1.60	8—5	58.00	97	1.06
.67	2— 3	33.82	64	1.66	1.50	3—2	56.31	95	1 11
.70	7—10	34.99	66	1.64	1.43	10—7	55.03	94	1.15
.71	5— 7	35.38	67	1.63	1.40	7—5	54.46	93	1 16
.75	3— 4	36 87	69	1.60	1.33	4—3	53.07	92	1.20
.78	7— 9	37.95	70	1.58	1.29	9—7	52.22	91	1 22
.80	4— 5	38.66	72	1 56	1.25	5—4	51.34	90	1.25
.83	5— 6	39.69	73	1 54	1.20	6—5	50 20	88	1 28
.86	6— 7	40.70	75	1.52	1.17	7—6	49.48	87	1.31
.88	7— 8	41.35	76	1.50	1.14	8—7	48.75	86	1 32
.89	8— 9	41.67	76	1.49	1.13	9—8	48.49	86	1.33
.90	9—10	41.98	77	1.49	1.11	10—9	47.98	85	1.34
1.00	1— 1	45.00	81	1.41	1.00	1—1	45.00	81	1.41

TABLE OF CHORDS OF ANGLES,

AT RADIUS OF SIX INCHES.

Degrees	Chord.	Tenths.	Degrees	Chord.	Tenths.	Degrees	Chord.	Tenths.
1	.10		31	3.20		61	6.10	
2	.20		32	3 31		62	6.19	
3	.31		33	3.41		63	6.28	
4	.42		34	3.51		64	6.36	
5	.52		35	3.61		65	6.45	
6	.62		36	3.71		66	6.54	
7	.73		37	3.81		67	6.62	
8	.84		38	3.91		68	6.71	
9	.94		39	4.01		69	6.80	
10	1.04		40	4.10		70	6.89	
11	1.15		41	4.20		71	6.97	
12	1.26		42	4.30		72	7.06	
13	1.36		43	4.40		73	7.14	
14	1 46	.1—.01	44	4.50	.1—.01	74	7.22	.1—.01
15	1.57	.2—.02	45	4.60	.2—.02	75	7.31	.2—.02
16	1.67	.3—.03	46	4.69	.3—.03	76	7.39	.3—.02
17	1.77	.4—.04	47	4.79	.4—.04	77	7.47	.4—.03
18	1.87	.5—.05	48	4.88	.5—.05	78	7.55	.5—.04
19	1.98	.6—.06	49	4.98	.6—.05	79	7.63	.6—.05
20	2.08	.7—.07	50	5.08	.7—.06	80	7.71	.7—.06
21	2.18	.8—.08	51	5.17	.8—.07	81	7.79	.8—.06
22	2.29	.9—.09	52	5.26	.9—.08	82	7.87	.9—.07
23	2.39		53	5.35		83	7.95	
24	2.49		54	5.45		84	8.03	
25	2.59		55	5.54		85	8.11	
26	2.70		56	5.63		86	8.18	
27	2.80		57	5.72		87	8.26	
28	2.90		58	5.82		88	8.34	
29	3.00		59	5.91		89	8.41	
30	3.10		60	6.00		90	8.48	

166.—THE TABLE OF CHORDS AT SIX INCHES.

When the lathesman is provided with a graduated compound rest which feeds the tool at any angle, nothing but the computation is required; but when there is nothing but the common square feed, the faces must be scraped with a broad tool. A templet for guiding the work can easily be made by means of the table of chords at six inches.

To lay out a given angle, draw an arc with a radius of six inches, draw a chord of the length given by the table for the angle, and then draw the sides *oc* and *ob* of the angle *boc*, Fig. 150.

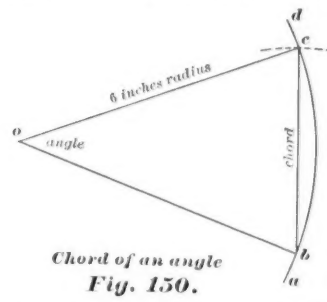
For tenths of a degree use the small tables. The chord of 37.5° is 3.81 + .05 = 3.86 inches.

Fig. 151 shows the manner of using the angle templet at the lathe.

This table of chords is very convenient for many purposes not connected with gearing, and it is more accurate than the common horn or paper protractor.

167.—BILGRAM'S CHART.

A graphical method for determining the angle and diameter increments, the invention



Chord of an angle

Fig. 150.

of Hugo Bilgram, is described in the AMERICAN MACHINIST for November 10, 1883. It determines the required values by the intersections of lines and circles, and requires no computation.

168.—ROTARY CUT BEVEL TEETH.

The most common method of forming the teeth of the bevel gear is by cutting them from the solid blank by the use of the common rotary cutter.

The cutter should be shaped to cut the tooth of the correct shape at the large end, and the small end must be shaped either by another cut with a different cutter, or with a file.

It is impossible to cut the tooth correctly at both ends, for the simple reason that the shape of the tooth changes, while that of the cutter is invariable. Therefore the result must always be an approximation depending upon the personal skill and experience of the workman. It is a too common practice to make the teeth fit at the large ends, and to increase the depth of the tooth toward the point, so that the teeth will pass without

Fig. 151.

Using the templet

filing, but such teeth can be in working contact only at the large ends.

169.—THE TEMPLET GEAR PLANER.

The most common method of planing the teeth of bevel gears is by means of devices adapted to guide the tool by a templet that has previously been shaped, as nearly as may be, to the true curve. The arm that carries the tool is hung by a universal joint at the apex of the gear, so that all of its strokes are radial, and a finger placed in the line of the stroke of the cuting point of the tool is held against the templet. There are many different arrangements for the purpose, but they are all founded on the same principles, and differ only as to details.

The invention of the templet gear planer is commonly credited to George H. Corliss,

who patented it in 1849, and was the first to use it in this country. But it was patented in France, by Glavet, in 1829, and may be even older.

It is largely used for planing the teeth of heavy mill gearing, but has not been, and cannot be, profitably applied to common small gear work. Its product is, in any case, superior to the rough cast tooth, but its accuracy is dependent on that of the templet, and is therefore dependent on personal skill.

The Engineers' House Warming.

A somewhat notable event in the history of the American Society of Mechanical Engineers was the "house warming" that occurred on the evening of November 28. We have previously mentioned the purchase of the premises No. 12 West Thirty-first street by the society, and shall refer to the building further on.

One of the occasions for this reunion of the members and ladies was the unveiling of a life-size oil portrait of the late Alexander Lyman Holley, a present from Mrs. Mary H. Bunker, formerly Mrs. A. L. Holley. And it was a happy thought that the unveiling of this painting, that truthfully represents on canvas one of the most prominent founders and the life-long friend of the society, should be made the occasion for a reunion of members and friends. It was singularly appropriate that, along with the formal presentation to the society of the portrait of one whose best efforts during life were ever at its disposal; whose endeavors were always in the direction of harmony and a wide feeling of brotherhood—that this time should be made the occasion for an effort to bring the members nearer together. It was what Holley, during his life, was always trying to do.

Some two hundred people gathered at the rooms, and, after inspecting them, came to order in the auditorium, and listened to an address of welcome by President Hunt, who, in a happy, off-hand manner welcomed every one, facetiously remarking upon the uncommon feature of welcoming people to their own home. A man became more a man, the president said, when he possessed a home, and the Society of Mechanical Engineers was now more than ever before a society, because it had a home.

President Hunt spoke in a pleasant and appropriate vein—just long enough, and not too long for the occasion—and his remarks were well received, and made an excellent impression. He then introduced Mr. James C. Bayles, who did the double duty of presenting the portrait of Holley to the society, and of receiving it on behalf of the society.

Mr. Bayles said that, in accordance with request, he should not eulogize Holley. In his address he referred more to his qualities as a man than as an engineer. He was ever truthful; ever faithful to those who reposed trust in him; ever willing to help those in need of his help.

At the conclusion of Mr. Bayles' address, Secretary Hutton outlined a plan for a continuance of reunions similar to the present one, but with such variations as might seem advisable, and the formal proceedings were brought to a close.

Then there was further inspection of the rooms, pleasant chats, a collation in the banquet room, and a gradual dispersion.

The new home of the society, and its arrangements for the transaction of the society's business, and for the entertainment of members, came in for many hearty expressions of approval, and it was more than ever made evident that this, the latest move of the society, will prove to be increasingly popular, as the members have opportunity to personally see what has been and is likely to be accomplished by it.

The location of the house could hardly be better. About midway between the Sixth avenue and Third avenue elevated railways, it is but a short walk from the Twenty-eighth street or Thirty-third street stations of either road, so that it may easily be reached from any point at either side of the city. In addition to this, Broadway is but half a block away on one side, while Fifth avenue is the same distance in the other direction, the former with its lines of street cars, and the latter its stages, so that four different routes are presented for going either up or down town, and all of them within easy reach of the house.

The house is of brown stone, 28 feet wide, 98 feet deep, and four stories high. Since its purchase by the society from the Academy of Medicine, it has been entirely refitted throughout, decorated and furnished—not elaborately or extravagantly, but in such a way as to make the rooms quite attractive and homelike, especially to the engineer, who will find about him a congenial atmosphere, well calculated to make him realize that membership in the society means something of real and practical value to him.

On the ground floor, the front room has been fitted as an office, committee and council room, and is also to be used as a clerk's room when not otherwise required. It is well supplied with tables and other furniture, and, like every other room in the building, is furnished with an abundance of incandescent electric lamps, by which it is brilliantly lighted at night. It is particularly convenient, and adapted to the purpose of a writing-room during the evening hours. Back of this room is a larger room, extending to the rear of the building, which may be used as a banquet-room.

The main entrance to the building is on the floor above this, a flight of stone steps leading up to the door of the hall, at the right of which, and in front, is the main office, in which the genial Mr. Allen will be found ready to lay aside his work to receive and welcome members and their friends who may call. This room is what may be called the reception-room, or members' rendezvous, and general headquarters. It is a pleasant and cheerful room, supplied with every comfort and convenience, including a telephone, which is in a corner at the rear of the room, partitioned off by glass to give privacy, and concealed by a handsome curtain, a similar curtain at the other side of the room concealing a wardrobe or small coat-room.

Back of the main office is the auditorium, which is two stories high, lighted from above by skylights and a large gas chandelier, in addition to which there is an abundant supply of incandescent lamps which are placed all about the room and at the front of the gallery, which is level with and really constitutes a part of the floor above. This gallery extends around three sides of the room and contains shelves for a library. Opera chairs are placed in circular order upon the main floor, and seats may also be provided in the gallery, the total seating capacity being about 250.

On a raised platform at one end are the chairs and table for the president and secretary, the table being fitted with an adjustable reading desk and electric lamp for convenience in reading professional papers. At one side and above the president's chair hangs the portrait of Holley, and it is understood that a portrait of the late Henry R. Worthington is being painted, which will occupy the space at the other side.

On the second floor is the library, which, with the gallery of the auditorium, occupies the entire body of the house. The shelves have been rearranged with special reference to an engineering library, there being special shelves for bound volumes of technical journals, etc.

In front of the shelves at frequent intervals are incandescent lamps having shades arranged at the side of them in such a way that the light is thrown onto the volumes only.

The central floor space of the library is occupied by long tables and chairs for the use of members in consulting the volumes, the tables being abundantly supplied with individual incandescent lamps with shades.

Opening off from the library, and also reached by a door leading from the hall, is the room of Secretary Hutton, in which is his desk, complete indexed files of all the papers which have ever been presented at society meetings, and in fact all else needed for the efficient transaction of the secretary's business. Speaking tubes put him in communication with his assistant in the main office below, or with the stenographer and typewriter on the ground floor, without the necessity for leaving his desk.

On the third floor is a large front room, which has been leased to the American Institute of Electrical Engineers, and is occupied by their secretary, Mr. Ralph W. Pope, as an office. On this floor and the one above it there are six rooms which have been fitted up as sleeping apartments, and which are at the service of members at a price below what equal accommodations can be secured for at good hotels, to say nothing of the fact that members who may be staying in the city and can make it convenient to use these rooms will not only have the library and other facilities for the transaction of professional business at hand, but will be very apt to meet other members, who may help them in various ways, and at least afford congenial companionship.

Steam and hot water heating apparatus, supplemented by open fires, bath rooms, electrical annunciators, metallic bedsteads, with special extra thick mattresses, and every convenience, are to be had, and it is hoped that the members will avail themselves of the privileges thus offered, as it is believed that it will not only benefit the society, but the members as well.

Meals are not furnished, but some of the best restaurants and hotels of the city are within easy reach, and it is not usually the case that an engineer visiting the city finds it convenient to get his meals at any one place, but rather to get them wherever it may be most convenient at the time. At present a member whose home is in Boston, and who is engaged for the time in professional work in the neighborhood of this city, has one of the rooms engaged for six months. It is believed that, as the members become acquainted with the house and its social and professional advantages, it will become a popular stopping-place for them when in the city, and it is desired that the entire building shall be made use of freely.

Why Some Boilers Explode.

A correspondent sends us a sketch of a boiler, in which the safety valve arrangement is an actual curiosity. First, the lever is loaded with the usual weight, and in addition it has supplementary weights of all sorts and conditions attached. He writes us:

There is frequently a great deal of discussion as to why a boiler explodes; perhaps the enclosed sketch will give you an idea in regard to the real reason why some boilers have exploded, though the one from which the sketch was made did not explode. It was running in the coal regions of Michigan, and was found by a boiler inspector in time to prevent perhaps a very wonderful and unexplained calamity. The enclosed is a genuine sketch of the weights as found, consisting of coal car wheels, car links, etc., besides the regular ball of 30 pounds. I think it would be well to give this to the readers of the AMERICAN MACHINIST, not that any of them would think of running a boiler in such condition, but very likely they may take warning, and keep such matters in mind when handling boilers. SAM'L E. JARVIS.

Navy Engineers.

Chief Engineer Melville's report, which has recently been submitted to the Secretary of the Navy, contains many points of interest, and, like the preceding annual report, is devoted largely to showing that the engineer officers do not receive the treatment that they should receive to attract the best men to the service. From the report we select a few passages as follows:

"It is with regret that I have to report that matters are now in still worse condition than they were a year ago, and that troubles that were mentioned as likely to occur are already apparent, for the number of engineer officers now in the service is not sufficient for the proper performance of the duties required of them. The number of engineer officers is now 194, of whom four have not had the proper engineering education and two at least did not wish to be appointed in the engineer corps. When my last report was published, but one ship (the Yorktown), with modern machinery, had been commissioned; since then three others (Baltimore, Charleston and Philadelphia) have been placed in regular service, each with one or two less engineer officers than they should have for safety and efficiency, and less than they would have if the corps was sufficiently large to permit the proper detail, but still more than will be possible when the number in the corps has been reduced to the legal limit of 170. As had been foreseen, the worry and anxiety undergone by these officers in their endeavor to keep things going and in order with the insufficient number of trained men at their disposal has proved too much for some of them, and they are breaking down. A policy which leads to such results can only be productive of disaster to the service. It requires a very simple calculation to show that the present legal numbers in the engineer corps will not be sufficient to properly officer the ships now in commission, and those for whose construction appropriations have already been made, and this without taking into account the number required for shore duty, and to provide for sickness and occasional leave, etc. Something must be done, and done promptly, or we shall not only have some serious breakdown to repair, which might have been avoided, but also an accident more than likely to be attended with loss of life.

"We not only need a very much larger number of officers in the engineer corps, but we also need a very much better course of instruction for the young men who are each year appointed into it. It is sometimes asserted that educated engineer officers are not needed for sea duty; that practical mechanics can do the duty just as well. Such statements can only be made by the assurance of ignorance. To separate the sea and shore duties of the engineer corps into two distinct branches will entirely destroy the excellent system which is the result of years of experience and trial, and which this bureau has always claimed as best for the efficiency of the navy—that is, the combination of the designer, builder, and competent user of machinery; for it is only by the actual working of the machinery at sea that many defects, either in design or construction, become apparent, and it is only when the experience gained by careful supervision and observation is afterward intelligently applied to other designs that the same or similar defects are avoided and improvements introduced.

"There is still another and very important point that is generally overlooked when considering the engineer corps of the navy, and that is that they are a part of the military organization, and second to none in importance. In the naval battle of the future the engineer staff will have a difficult and important part to perform, and if there is failure in the engine-room no amount of skill and bravery on the bridge may suffice to avert disaster. Celerity of movement has decided many a naval battle and will decide many more, and the celerity of movement of a modern ship depends directly on the skill of her engineer officers."

The *Tribune* has the following special from Topeka, Kan.: The charter of the Omaha, Kansas Central & Galveston Railroad Company has been filed with the Secretary of State. The capital stock is placed at $18,000,000, and the estimated length of the proposed road is 500 miles. The charter was filed by C. M. Rawlins, of Lyons, Kan. He says that all necessary funds have been pledged. Work will begin at Superior, Neb., the terminus of the Chicago & Northwestern. The directors of the company are Valdelo Sillo, Gustavus A. Buck, Jacob Newberger and George H. Bailey, of New York, and D. M. Bell, Alonzo Jones and C. M. Rawlins, of Lyons.

A new roofing material is mentioned in the German papers in the shape of a sort of metallic slate, somewhat similar to that used among us, but enameled so as to be proof against moisture or acid vapors. Metallic slates of tin and galvanized iron have long been used in Germany, and galvanizing has been pronounced by the highest scientific authority there to be the best protection against rust that has yet been applied to iron.

Mr. James F. Hobart, at one time on the editorial staff of the AMERICAN MACHINIST, has accepted the position of editor of the *American Journal of Railway Appliances*.

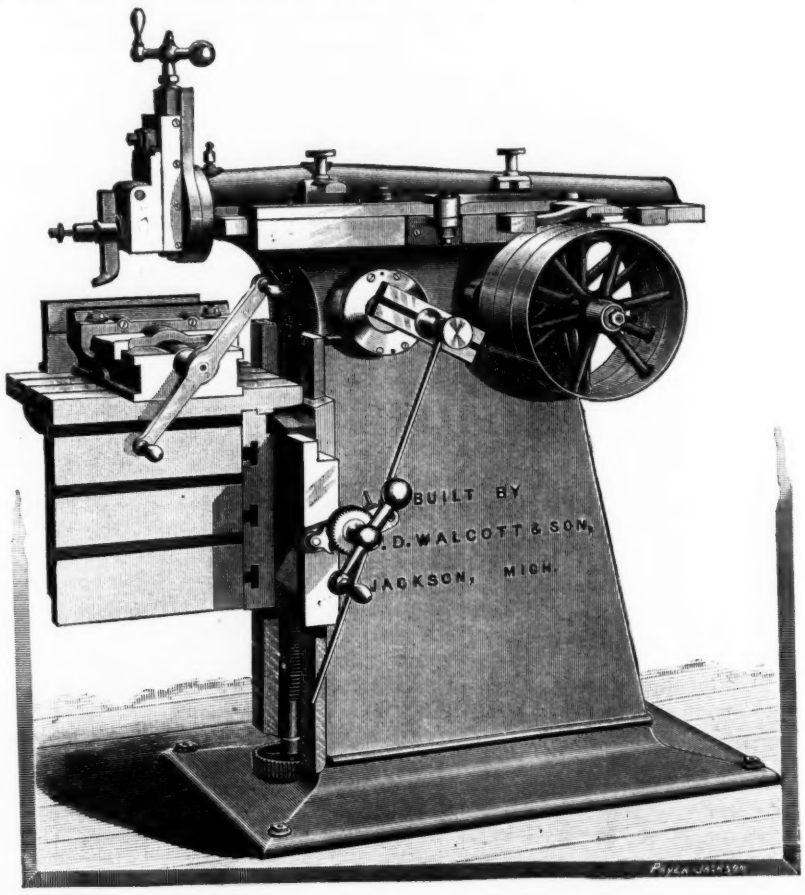
If the proposed amendment to the constitution of mechanical engineers becomes law two members must be put in nomination for each place falling vacant.

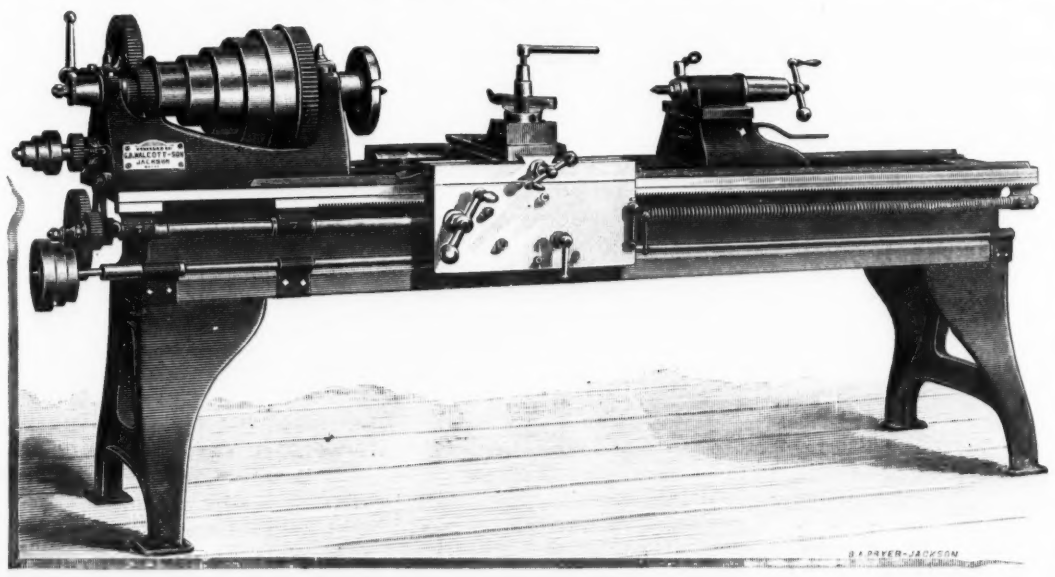
Shaping Machine and Lathe.

On this page we present illustrations of two standard machine tools which have recently been brought out by Geo. D. Walcott & Son, Jackson, Mich.

The shaper, as will be seen, has a very heavy and substantial base, and the ram slide is unusually long. The ram is driven by rack and pinion movement and shifting belts, the motion being uniform throughout the stroke, and the same for all strokes. An opening which passes entirely through the machine under the ram admits of a shaft being passed through to be key-seated, or otherwise operated upon. The machine possesses all the features usually found upon tools of its class, and when desired, is furnished with graduated swiveling chuck, automatic down and angular feed, and various attachments for circular work, key-seating pulleys, etc. It has a stroke of 22 inches, and automatic motion of cross slide of 22 inches. The table is 12x17 inches, and its greatest distance from the tool 18 inches. The countershaft is arranged for two speeds.

The lathe is 18 inches swing—11 inches over the carriage, and has a five-step cone, the largest step of which is 12 inches diameter. The back gears are proportioned twelve to one. The front bearing of the spindle is 2⅞ inches diameter, 5 inches long. There are independent rods and screw feeds, and automatic cross-feed; gears being used entirely to the exclusion of friction feeds. Footstock is fastened to the bed by a single motion of a lever. The lead screw, rack and all small pinions, shafts, studs and screws are of steel. When desired, it is furnished with compound rest, taper attachment, or hollow spindle.





Economy in the Machine Shop.

BY A MECHANIC.

Every one has heard the saying, "Economy is wealth," so many times that it has become a common byword. This saying is no doubt a true one when applied the way it was intended to be applied, but we often see economy which wealth does not follow. In the machine shop where I have seen the greatest economy practiced, I believe by appearances there was the least money made. In the old-time shops drills were forged with square shanks to fit a square socket in the machine spindle. I have seen such drills made with a very small piece of steel welded in for a point, and the rest of iron; after a little while this steel got worn off, and I have often seen the workmen trying to harden an iron drill by the use of potash.

Of all the economy I ever saw practiced in such a shop, that much-abused grindstone came in for an overdose. In the shop where I served my apprenticeship the foreman was very saving of his grindstone. He hated awfully to see it turned, for it wasted so much of the stone. When the stone got to running out about 8 inches, some workman's patience would give out, and, after getting a good piece of gas pipe, he would settle down for a long job. The foreman would come around and stand looking at him, with his hands locked behind his back (as he would always stand when in deep thought), and caution him about getting too much off. "I wouldn't take it quite out," he would say. I don't think the foreman was so much to blame either, for he always had an awful hard time to get a new one. The proprietor seemed to think that all money paid for grindstones was wasted.

Some workmen are very wasteful of the shop supplies, and for a remedy the managers have devised various means of preventing waste. One plan I have seen was this; The foreman had charge of the supplies, such as waste, files, emery cloth and such things, and when a workman wanted them they were expected to ask him. His duty was to growl and kick at every want, and he did it in a way that no one could find fault with. He was not a bad man. I think he was quite a good man, but this was his duty and he did it. I believe it is the most economical plan I have ever seen in use, as far as the supplies are concerned; but let us look at the other side of the question. The workmen did not like to hear all this growling and kicking when they wanted a file or any such thing, and they would not ask till they could not go longer without. There is a point to which a file may be used, where a further use is a loss, and in this shop files were used on the loss side longer than on the other side.

I remember one job I had to do in that shop that had to be finished pretty nicely, and all the work had to be done with files and emery cloth. It was a difficult shape to file well, and I had to use considerable emery cloth to get the scratches out. The foreman thought I did not use the emery cloth all up. I would work for hours trying to wear scratches out with a piece of greased rag; at last I got out of patience, and went down town in the evening and bought 15 cents worth of emery cloth, on my own hook. I had a knock-out argument for him, if he came around "kicking" about my not using that cloth up fine enough, but he was too sharp; he did not complain.

In some shops they are trying the "order plan."

Anything that the workman is supposed to be wasteful of, or some tool which he is thought likely to damage by common work, he is obliged to get an order from the foreman for. Let us see how this works. Some little combination center drills and reamers were bought, and as they were supposed to be easily broken, they were kept in the tool-room, and only allowed to be taken out when an order from the foreman accompanied the usual check. These tools were bought for convenience. They were not a necessity, but were bought because it was thought work could be done more cheaply by their use. An apprentice or a laborer might go to the foreman and ask his advice about whether he needed these center drills or not, but a journeyman who had worked at the business as long as the foreman had, and was as well acquainted with every detail, perhaps better, ought not to be expected to. Good workmen will never do these things as long as they can do without, and so such tools get to be used mostly by apprentices and laborers, who are most liable to break them, therefore the rule that is made to force economy defeats the whole business.

In the AMERICAN MACHINIST of Oct. 2d. Mr. Wathey tells of this "order plan" being introduced in a foundry. He says one keg of nails lasts for five weeks with the plan, against five kegs for one week without. This certainly shows economy in nails, but whether it is great economy in the foundry no one can decide till he has heard the evidence from the other side. It is also true that if the foundry did no business for the five weeks no nails would be used. Good workmen might go without nails when they needed them, and as a little "hitch" in each one's work amounts to a great deal among many, there might be a loss in work that would more than overbalance the saving in nails. I do not doubt that some careless workmen waste nails, but the question is, is this the best way to stop waste?

I am much interested in the "Sketches of an Apprenticeship" by Mr. Rogers. In Oct. 9th issue he tells of the very economical plan for stopping the waste of breaking tools. I believe it would be a good plan to let an honest, intelligent apprentice break drills as he saw fit for one week, for it would give him a good chance to learn how much a drill would bear. Are there not a great many workmen who go through life, never knowing what any tool will safely bear, and who never get anything like the amount of work from tools they ought to for this reason?

Suppose on a railroad a good strong locomotive was never used under a steam pressure of more than ten pounds, because no one ever went to the trouble of finding out if it could bear more. It is not always necessary to blow up a locomotive boiler to find out how much it will bear; there are other ways of finding this out; but I do not know of a more practicable way of finding the strength of a twist drill than to break one. In the case spoken of by Mr. Rogers, the "old man" charged him twice for his lesson. He hired him for small wages, under the agreement that what he should learn would make up the difference. The system of charging is a very popular one, for the same reason that whisky is thought by some people to be the best remedy for all complaints; it is easy to take. There is another plan which is not so popular; it is this: Pay good wages to honest, intelligent workmen, to show that their services are appreciated, and as an inducement for them to do their best, and also for an inducement to get more of such men. This is not so popular, for it is harder to take.

I know there are a great many careless, indifferent workmen, and that a few of such men set a very bad example in a shop. It is easier to fall into a careless habit than to reform. I know of a man who was a great talker in the shop. He always had a long story to tell, in which he was the principal hero. He seemed to be perfectly indifferent about his work. One day he was chucking a piece in a small lathe, with a big drill, and at the same time was telling his neighbor on the next lathe a wonderful story. He could not stop feeding till he finished his story, and before that, the drill had got through the work, and was going into the spindle. All of a sudden his story was stopped short, for the chuck dropped off the spindle. He had bored the spindle out of it. It is needless to say that such a man is not a desirable one, and I believe the ones who will employ such a man make about the right profit.

I know of another case; of a man who was always reliable, intelligent and industrious. He always tried to do his best, but one day, from some unknown cause, he ran a drill into the lathe spindle. To say that he felt bad for this accident would be putting it very mild. He would not have felt so bad if it had been his own. Was it necessary to charge this man for the accident, to guard against his doing a similar thing again? I think not. The mere fact that he had damaged the lathe from carelessness was enough. All good, intelligent workmen want to make a good appearance in the shop, and there is nothing they dread so much as to get into a "muss" like this. I believe it will be found very difficult to devise a scheme to force men to be honest and economical, and still get the most work. If you want to hire a man to look after your finances, in a place where he has a good chance to steal, in order to prevent him taking all your ready money and going on a trip to Canada you hire a man who you believe is honest, and who would not take this advantage. You would not put a known rogue in such a position, and try to frame some scheme to prevent his

being dishonest. Why doesn't this apply to the shop as well?

There are lots of chances for dishonest, indifferent, careless workmen, and it will be found difficult to change this state of affairs. Machine shop proprietors are not careful enough about the class of help they hire. Good, intelligent machinists cannot be hired for $1.50 per day, but some people seem to think so. I was talking with a foreman a few days ago about a handy little tool. He said: "It wouldn't be of any use here, for they will break anything within their strength." Would it not be better to employ more intelligent men, even if they cost considerably more, and supply them with the most convenient tools?

I know a young man who is a good machinist, considering his experience, and is one who would be a desirable man in a machine shop. He applied to the foreman in a shop a few days ago for a job. The foreman would not stop and speak to him even, but walked straight by, only saying he did not have time to talk to him. There is probably a lack of skilled mechanics, and I believe it is the small inducement offered that makes it so.

LETTERS FROM PRACTICAL MEN.

Building a Small Machine Shop.

Editor American Machinist:

In making a few suggestions for your correspondent who is about to build a small machine shop, 35x75 feet, I would say:

Make a nearly flat tar and gravel roof, supported by 3″x14″ rafters 18″ apart. This will be stiff enough, except in regions of heavy snow, without center posts, which are an abomination in any shop; and even in a heavy snow it would be better to spend an hour shoveling than to waste time and piety cursing posts which are always in the way and will not out.

Roof boards should be tongued and grooved for tightness and stiffness. If the walls are to be of wood, 2″x4″ studs, 18″ apart, *directly under the rafters* will do.

In spacing for the studs on the sills, put in two and leave out one *all the way around*. These openings are for windows, of which you cannot have too many, and they cost next to nothing extra.

Let the windows start just above the bench—just high enough to keep things from rolling out when the window is open, and low enough to allow the workman of inquiring mind—and none other are worth having—to look out without wasting valuable time climbing on the bench or hunting a block.

A man with the right kind of snap to his intellect, cooped up within dead walls, is like a spirited horse with blinders—nervous and restless. Remove the blinders, and knock holes through the walls, and you have a better horse and a better man.

Stringers on the top of the studs, on which the rafters are toe-nailed without cutting, except as to length, is good, practical and cheap.

Sills 6″x6″, half checked together at the corners, and well spiked with 5″ nails, will do.

Doors will be placed to suit the premises, and made wide enough to admit or emit anything that may come or go. If the shop is to be a jobbing shop, and some uncertainty exists as to the bulkiness of future machines or jobs, you had better make the doors—at least the main one—as wide and high as you dare, with the chances that you will some time wish it was three inches wider or higher.

Make the windows high—*up to the roof*. One upper pane is worth two lower ones for light, and costs no more.

If the climate is cold, ceil the outside with cheap tongued and grooved stuff, cover with building paper, and put on tongued and grooved weather-boards, with 3″ battens; or, if preferred, use novelty siding. Put on the building paper before the window frames are put in, and let it run to the window openings.

A little care and expense in making the walls will be time and money well spent; and the beauty of the matter is that it will only have to be spent once, whereas the coal man, with his little or big bill, is an ever and oft-recurring calamity.

Ceil the inside with good tongued and grooved stuff, without beads.

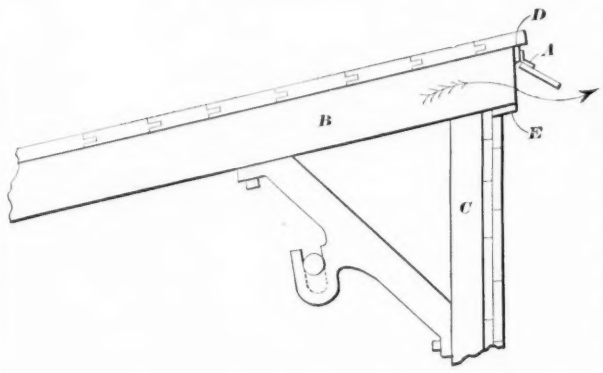
The sketch shows the ventilators. The shutter *A* is hinged to the strip *D*, which is nailed to the rafters *B* and to the roof boards. The shutter closes against the strip *E*, nailed to the rafters snug up to the outside ceiling. With this arrangement the air can pass out and in, but the rain and most of the snow must stay out. In fact, as the shutters will never be open in winter in a snow country, you need borrow no trouble on that score.

The sketch also shows what may be called a brace hanger for the line shaft. This would be better placed at the high side of the roof, and has the double advantage of being at the most stable part of the roof, and adding its bracing stiffness to the general stability, and the shaft is more certain to be kept reasonably in line than when hung at the middle of the roof without center posts. This is an important consideration, in view of the information we have lately received through your paper in regard to the enormous percentage of coal wasted in driving tortuous line shafts.

If your correspondent chooses to put himself in communication with me, I think I could put him in a way of finding a cheap self-oiling hanger of this sort, in which a shaft has been known to run 200 revolutions a minute, ten hours a day, for a year, with once oiling.

I purposely began at the roof, in order to leave the floor to the last as a good, solid climax.

Level the ground, and put in gravel or cinders to a depth of 6″, in which solidly bed



round 4″x4″ flush with the surface. Pound down and trim the gravel, leveling the whole business with a spirit level, and long straight-edge, so that the floor planks will bear all over.

Norway spruce, or good hard Southern pine, not more than 6″ wide, and not less than 1½″ thick, planed and jointed, but not matched, and well nailed to the 4″x4″, will make a floor fit for machine tools anywhere. Do not use hard wood unless you wish to slip down and break a leg carrying a heavy casting.

BENJ. F. WILSON.

Critical Notes.

Editor American Machinist:

There seems to be considerable variety of opinion about the value of the swivel or adjustable head lathe, but I think this arises mostly because each one has in mind some particular class of work for which a lathe might be used.

A head-stock that can be adjusted to keep the spindle in line with the carriage ways is fully as desirable in every way as to have the tail stock adjustable, and nearly all the objections that have been made to it would apply with equal force to the tail-stock adjustment, yet no one has the courage to raise objections to the tail-stock adjustment, because it has been in use so long that it is beyond the critical period.

Every machinist who has run lathes knows that all lathes eventually reach a period when the tail-stock will be fully decorated with center marks both public and private, but that does not condemn the adjustable feature, nor prevent a good machinist from getting all the benefit of its use. I should say it was not a very good way to test the "alignment of a lathe by boring a hole with a long, slender boring tool," and a machinist who could think of no better way of getting a swivel head set in line does not deserve to have the privilege of running such a lathe, but ought to run a grindstone or a wheelbarrow. In a shop doing large quantities of general machine work, not all the lathes would need to have taper attachments or even swivel heads, but several lathes of different sizes ought to be so that any kind of taper or bevel work could be done on them.

Neither the taper attachment, the swivel head nor the compound rest alone is capable of doing all classes of taper work. The taper attachment if made of any considerable length, say four feet, is limited in its angular range, and if made short, so as to have more angular range, it will not work well, and is limited in length. The compound rest is not limited in angular range, but is limited to a short feed range, but it will do what neither of the others will, that is, turn a wide angle taper at the end of a long shaft. With this exception the swivel head will do all that the compound rest will, and, besides, will turn square with whatever angle it faces or bores, without readjustment.

The compound rest cannot conveniently be made to cut a tapering thread, but this can be done with the taper attachment or the swivel head. With a taper attachment having one long guide bar, and one or two shorter ones, a greater variety of taper work could be done than with either the swivel head or compound rest alone.

I think it very doubtful if it would be any cheaper to cast the head-stock on the lathe, for there is considerable work to be done on the head-stock, and, while doing that work, the whole lathe bed would have to be handled for each operation; so with lathes having a long bed it might easily cost the most that way.

The split taper bush for taking up the wear of the spindle is not mechanically correct, because it can only fit the hole at one position, and, if drawn in farther, will not fit properly, and, therefore, will not be seated solidly enough to prevent giving when the strain comes on the spindle.

Regarding the fitting of a face-plate to the spindle, it is true it can be readily fitted to a straight, turned part back of the thread to center it, but it will not be in use long until that part will be worn so loose from frequent removals that it will no longer center it exactly, and then the thread will have to be depended on for that purpose. But if a taper fit, a straight thread and a square shoulder to stop against is used instead, and the taper gets worn so it does not center accurately, all that is necessary to remedy this is to face off the spindle shoulder, and thus allow the face-plate to go a little farther on the taper part until it does center.

If Mr. Booth offers his straight-way valve as a successful example from actual practice—I do not wish to criticise—but if he offers it as a suggestion to be adopted, I think we have plenty of better straight-way valves in use in this country. Taking the leverage of the screw and the toggle together, it is well calculated for the purpose of not only shutting it tight, but splitting the casting or forcing it on the seat with a pressure that would distort or crush the surfaces at the seating. There are some straight-way valves in use here in city water service under very high pressure, which are tight and durable, and are more simple and less liable to get out of order than the toggle joint arrangement.

BELL CRANK.

The Relative Value of Lubricants.

Editor American Machinist:

Speaking once to the driver of a L. & N. W. engine, the writer was told by him that he could run as well with seven N. E. cars as with six of the L. & N. W. cars. Asked the reason, he attributed the difference to the fact that one company used grease for its axles, and the other company used oil. The oiled cars were the easier to haul.

It would appear that a grease of semi-solid consistency, such as used on English freight cars, and formerly on passenger cars of all lines, requires to be occasionally pressed down towards the axle; when an axle warms the grease flows, becoming fluid; and greases of different composition were used in cold weather, so as to be more fluid at low temperatures than the summer grease. A hot axle would thus deluge itself with melted grease; a cold axle would run till it ran dry, and then melt down a fresh run of grease. Oil-boxes with pads and felt wicks keep up a constant supply, and, though thin and easily squeezed out, the pad as quickly re-distributes a film of oil over the whole journal. It is no doubt due to the case with which a thin oil can be constantly and evenly applied, as compared with a less easily expressed grease, that oil owes its superiority.

Laboratory tests of lubricants are very well in a way, but need to be sorted up with brains. They do not tell us why a mixture of a thin mineral oil with an equal quantity of sperm gives such excellent results in many cases, nor as a rule do the professional oil testers seem to give sufficient attention to kindred questions. An oil may improve a mixture by reason of the protection it affords against a slight acidity of one constituent. Again, one oil may act simply to keep the air away from the particles of another oil, which would otherwise oxidize or gum if not, so to speak, varnished over. Body is often most delusive in an oil, and a bearing will heat with an oil of body, and run cool with a thin oil far less copiously supplied.

In engine shafts, considerations of bending stress from long overhang may put a limit to length of neck, which considerations of lubrication would not sanction. In such cases, oil pumps, giving copious circulation on the journal, can be used to allow of minimum dimensions.

It is often thought that railroad service is the severest test for oils. This is by no means certain. The end motion on every car or engine journal is a powerful factor in producing a good journal surface free from grooves or ruts.

W. H. BOOTH.

The Measurement of Power.

BY J. J. FLATHER.

THIRD PAPER.

Although the engine indicator is an instrument for measuring power, as it neither transmits nor absorbs the power, its discussion will not be entered into in these pages—the question is not how much power will a motor develop, but: How much will a machine absorb?

The use of the engine indicator in connection with a new form of transmission dynamometer designed by the writer will be shown farther on. Among the many machines and devices for measuring power already known to the engineering world, one of the simplest is the Prony friction brake; and but for certain disadvantages attendant on its use it would possess a superiority to all other contrivances.

Primarily this consists of a lever *L*, Fig. 1 (page 7), connected to a revolving shaft or pulley in such a manner that the friction induced between the surfaces in contact will tend to rotate the arm in the direction in which the shaft revolves. This rotation is counterbalanced by weights *P*, hung in the scale pan at the end of the lever. In order to measure the power for a given number of revolutions of pulley, we add weights to the scale pan and screw up on bolts *b b*, until the friction induced balances the weights and the lever is maintained in its horizontal position while the revolutions of shaft per minute remain constant. That this measure of the friction (if we disregard heat) is equivalent to a measure of the work of the shaft will be seen when we consider that the entire driving power of the shaft is expended in producing this friction at the required number of revolutions per minute—and this driving power is equal to the mechanical effect of

the shaft when running at the same speed in the performance of useful work.

For small powers the beam is generally omitted—the friction being measured by weighting a band or strap thrown over the pulley. For very delicate work, cords are often used for the same purpose. The writer has in mind a case where a cord not over $\frac{1}{16}$th inch in diameter was used for testing the power of a water motor; the power developed averaging only 0.013 H. P., at a speed of 2,000 revolutions per minute.

Instead of hanging weights in a scale pan, as in Fig. 1, the friction may be weighed on a platform scale; in this case the direction of rotation being the same, the lever arm will be on the opposite side of the shaft.

A modification of this brake, in which the lever acts on a platform scale, is that in use in the Sibley College laboratories, and is shown in Fig. 2. The brake wheel is keyed to the shaft, and its rim is provided with inner flanges about two inches deep, which form an annular trough for the retention of water to keep the pulley from heating. A small stream of water constantly discharges into the trough and revolves with the pulley—the centrifugal force of the particles of water overcoming the action of gravity; a waste pipe p, with its end flattened, is so placed in the trough that it acts as a scoop, and removes all surplus water. This arrangement was first used by Driut Halpin, in England. The brake consists of a flexible stap to which are fitted blocks of wood forming the rubbing surface; the ends of the strap are connected by an adjustable bolt clamp, by means of which any desired tension may be obtained.

The horse-power or work of the shaft is determined from the following:

Let W = Work of shaft, equals power absorbed per minute.

P = Unbalanced pressure or weight in pounds, acting on lever arm at distance L.

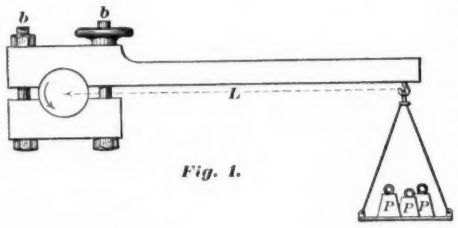
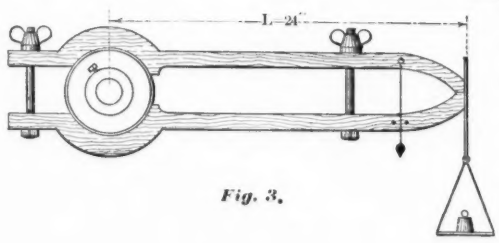


Fig. 1.



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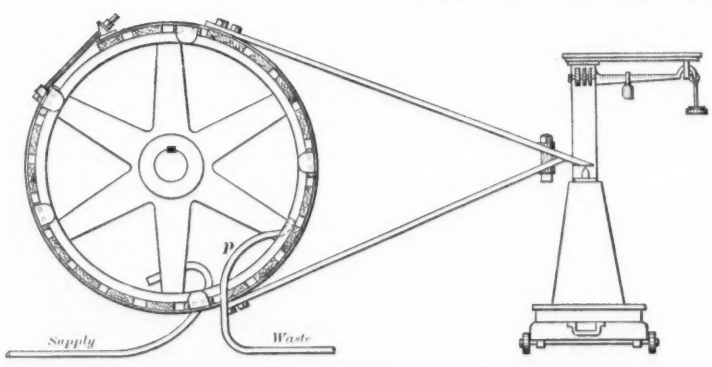


Fig. 2.

THE MEASUREMENT OF POWER.

L = Length of lever arm in feet from center of shaft.

V = Velocity of a point in feet per minute at distance L, if arm were allowed to rotate.

N = Number of revolutions per minute.

$H.\ P.$ = Horse-power.

Then will $W = P\ V = 2\ \pi\ L\ N\ P.$

$$\text{Since } H.\ P. = \frac{P\ V}{33{,}000}, \text{ we have}$$

$$H.\ P. = \frac{2\ \pi\ L\ N\ P}{33{,}000}$$

$$\text{If } L = \frac{33}{2\ \pi} \text{ we obtain } H.\ P. = \frac{N\ P}{1{,}000}$$

$\frac{33}{2\ \pi}$ is practically 5 feet 3 inches, a value often used in practice for the length of arm.

With the ordinary form of lever brake, in order to maintain a stable equilibrium of the lever the weight should be supported on a knife edge and act below the center of the shaft. In this case, when the weight falls or rises, through any irregularity of the brake, the lever arm is decreased or increased, and the slight irregularity is overcome by a corresponding change of moment; whereas, if the weight act above the axis, any increase or decrease in weight will cause it to act through a longer or shorter arm, as the case may be, and the lever cannot of itself come back to its horizontal position. This does not apply to that form of brake where the force is measured on a platform scale, as it is evident the lever arm is practically constant. Although the construction of the lever is of great importance, Mr. Heinrichs has shown that the proportions of the brake for different horse-powers is even more important in order to obtain uniformity of test.

From a number of experiments made with a Prony brake of the design shown in Fig. 3 Mr. Heinrichs gives the following dimensions as being most suitable for the horse-powers designated.*

DIMENSIONS FOR PRONY BRAKE.

To Measure.	No. revs per m. of brake pulley.	Size of Brake		Dia. of brake pulley.
		Leng'h.	Width.	
From 2 to 5 Horse-power	1,200 to 1,800	24″	1⅝″	4″
	700 to 1,200	24″	2⅝″	6″
From 5 to 8 Horse-power	1,200 to 1,600	24″	2⅛″	6″
	800 to 1,200	24″	4 ″	6″

In using a brake of this kind, if the surface in contact with the pulley be too large, it will be found that a considerable weight may be added to the scale pan without materially altering the position of the lever arm; but if, on the other hand, this rubbing surface be too small, the resulting friction will show great irregularity—probably on account of insufficient lubrication—the jaws being allowed to seize the pulley, thus producing shocks and sudden vibrations of the lever arm. The material in contact with brake pulley, no doubt, enters largely into the question of smooth running, especially if the lubrication be not of the best. Soft woods, such as bass, plane tree, beech, poplar, or maple are all to be preferred to the harder woods for brake blocks. Old leather belting, oil soaked, secured to wooden blocks, forms a good rubbing surface, and maintains a very regular motion of the brake. Babbitt metal, turned to fit the rim of pulley, has been suggested, and would probably give excellent results, if lubricated properly, but the writer is not aware that such blocks have been used. Mr. W. W. Beaumont, in an admirable paper on "The Friction Brake Dynamometer," has deduced a formula by means of which the relative capacity of brakes can be compared, judging from the amount of horse-power ascertained by their use.

If W = width of rubbing surface on brake wheel in inches;

V = vel. of point on circum. of wheel in feet per minute;

K = coefficient; then

$$K = \frac{W\ V}{H.P.}$$

The writer has made independent calculations from data furnished in the paper just referred to, and has obtained the values of K, given in the seventh column of the subjoined table:

CAPACITY OF FRICTION BRAKES.

Horse-power.	R. P. M. brake pulley.	Brake Pulley. Face in inches.	Brake Pulley. Dia. in feet.	Length of arm.	Design of Brake.	Value of K.
21	150	7	5	33′	Royal Ag. Soc., compensating	785
19	148.5	7	5	33.38″	McLaren, compensating	858
20	146	7	5	32.19″	McLaren, water-cooled and comp.	802
40	180	10.5	5	82′	Garrett, water-cooled and compensating.	741
33	150	10.5	5	32″	Garrett, water-cooled and compensating.	743
150	150	10	9	.....	Schoenheyder, water-cooled	282
24	142	12	6	38.31″	Balk	1385
180	100	24	5	126.1″	Gately & Kletsch, water-cooled	209

Mr. Beaumont's average value of K for a comparison of three brakes (included in the above) is 860. By referring to the table it will be seen that the above calculations for eight brakes give values of K, varying from 209 to 1,385 for actual horse-powers tested, the average being $K = 720$. By a comparison of the sizes and speeds given by Mr. Heinrichs (see table), K is found to average 895 for small horse-powers, varying from 2 to 8. From the nature of the device these latter brakes are not water-cooled.

In the Gately & Kletsch water-cooled brake (for description of which see article by Prof. R. H. Thurston, in Jour. Franklin Inst., April, 1886), the wheel was designed to measure 540 horse-power, but it does not appear to have been used to indicate more than 180 horse-power.

For this number $K = 209$.

In the Schönheyder water-cooled brake $K = 282$, so that it would appear by a comparison of these two brakes that the water-cooled rim allowed a less amount of rubbing surface per minute per horse-power. But it will be noticed that several other brakes are also water-cooled, and give an average coefficient of 762. In all of the latter, however, the brake-strap is compensating, and in every case where a compensating device is used it is found that the area of rubbing surface for a given horse power is larger than in the water-cooled brake without such arrangement.

Instead, therefore, of assuming an average coefficient, the writer would propose the following:

$K = 250$ for water-cooled brake, non-compensating.

$K = 750$ for water-cooled brake, compensating.

$K = 900$ non-cooling brake, with or without compensating device.

Using these values of K, the width of brake wheel can be calculated for the different types from:

$$W = \frac{250\ H.\ P.}{V};$$

$$W = \frac{750\ H.\ P.}{V};$$

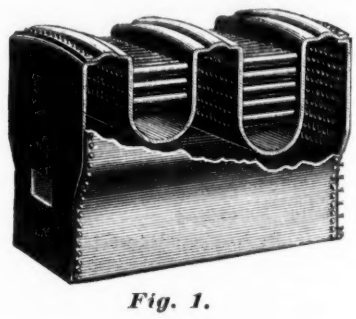
$$W = \frac{900\ H.\ P.}{V};$$

in which, as before, W = width of bearing surface in inches on pulley, and V = velocity of a point on the circumference of pulley in feet per minute.

In the different forms of Prony brake, it is evident that as the work of the shaft is all spent in overcoming the resistance due to friction, no useful work is done. The friction brake is thus an absorbing dynamometer.

A New Boiler.

We show in the principal cut herewith a new form of boiler, and in Figs. 1 and 2 different forms of fire-boxes. In Fig. 1 the staying of crown sheet is dispensed with by the insertion of tubed transverse water legs, which cross the fire-box and are riveted to the sides. This construction increases the heating surface, and also the water capacity.



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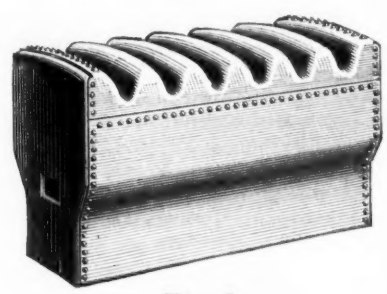
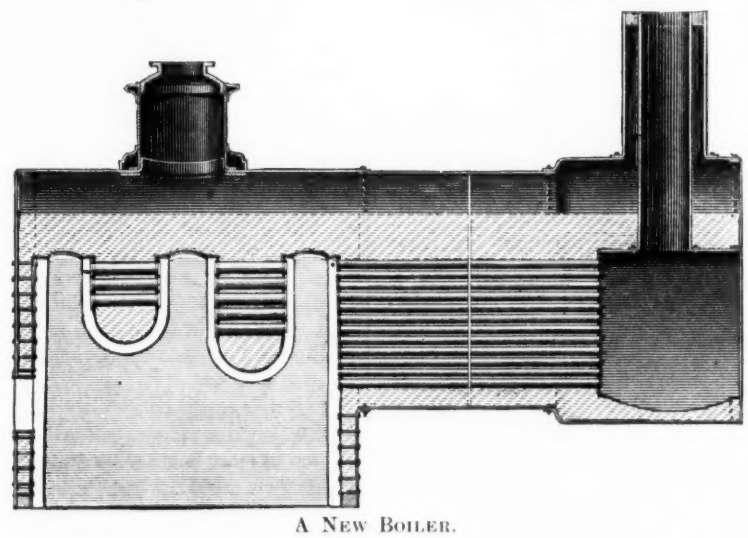


Fig. 2.



A NEW BOILER.

In Fig. 2 strength is given to the crown sheet by means of corrugations running directly across the fire-box, a flange being formed at right angles with the top of the fire-box, so there will be no weak place where the corrugations terminate.

As shown, the smoke-box is encased so as to dry the steam and utilize heat as much as practicable. This casing can be dispensed with in cases where it is necessary to do so. The construction is sufficiently shown by the engravings to render further explanation unnecessary.

The inventor of this boiler is Mr. William Malam, 142 Oak street, Paterson, N. J., lately manager of the boiler department of the Edgemoor Iron Company, and a boiler maker of extended experience in this country and in England. While none of these boilers have been made, he feels sure that they can be made of ample strength for any service, including locomotive service, without staying, and that they can be constructed at a reasonable cost.

It is proposed to hold an international congress of engineers at Chicago during the Columbian Exposition. Committees have been appointed by the several engineering societies to be represented, and some progress has been made. It is believed that an assessment of one dollar upon each member of the societies will meet the expense.

* Mechanics, 1884.

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Politics in the Shop.

By means of the newspapers and otherwise, considerable attention has been drawn to an occurrence which took place shortly after the recent election at the shops of Russell & Co., at Massillon, Ohio.

The report as first published was to the effect that, on the day after election, some thirty or more men, who had voted the ticket not approved of by the firm, had been practically discharged for so doing by having their wages reduced about one-third. Of course, no such action can be taken anywhere or by any firm of manufacturers in this country without attracting considerable attention. The discussion which resulted from it in this case finally led to a conference between a committee representing the discharged men and Russell & Co., at which the latter explained that action was not taken against the men on account of their politics, and that politics had had nothing to do with it, except that political feeling had led the men to the doing of things in the shop which were not only offensive, but inconsistent with good order, discipline and efficiency. Attention was also called to the fact that about two hundred other men of the same political faith were employed, and these had not been disturbed.

Without attempting to decide upon the merits of this case, we can say, nevertheless, that, having had considerable opportunity for witnessing the effect of politics upon machine shops, we believe that that effect is very nearly always bad. The discussion of political matters among the men during working hours is always demoralizing in its effect upon the shop.

No mechanic, we think, who stops to consider its effect and its relation to the work he is employed to do, will want to spend time during working hours in such discussions. Those who do wish to so spend their time have no just cause of complaint if their employer takes measures to prevent their doing it. But in taking this action, the employer should be careful to pursue an impartial course, and set the proper example. It is politics as a whole, not some particular brand of politics only, which should, in the interest of both employer and employe, be tabooed in the shop.

We have never been able to discover that men belonging to one political party were any less or more liable to waste time belonging to their employer, or to do things subversive of discipline and shop efficiency than are those belonging to any other party. The only consistent, fair and safe course is to recognize the fact that politics and shops do not go well together, and act accordingly.

Outside the shop it is a man's privilege, if not, indeed, his duty as a citizen, to exert in every proper way the full power of his influence in favor of the political faith which he conscientiously believes to be right. Inside the shop he has, or should have, other business, and should strictly attend to it. This applies not only to men of every and all political beliefs, but to employer and employe alike.

It may be said, and with some force, that a man who owns a shop should have the right to do as he pleases within that shop in regard to these matters. Granting that he has such a right, it still remains a question of business policy as to whether he should exercise it or not. If he brings his politics into the shop, or allows others to do so, he must expect the politics of others to also be brought in, and the result can but be injurious to him as a manufacturer.

Let Mr. Smith, of the firm of Smith, Jones & Co., take such political action as seems to him proper. Let Mr. Jones do the same. But as a company organized for the manufacture of machinery, let them see to it that no political action is taken by them, and that their only business is the manufacture of machinery, and the making of money thereby if possible. Most of the men employed will take their cue from this, and keep their politics separate from their work. Those who do not may fairly be given to understand that that is what is required. Machinery has no political complexion.

Not only do we believe this to be the best policy with regard to the business interests involved, but we believe, also, that an employer does the most effective work for his own political party who does it entirely outside of, and without any connection whatever with his shop.

There are many indications that within the next few years there are to be some political struggles in this country, which, for intensity and partisan bitterness, have seldom, if ever, been surpassed. Our interest in, and friendship for, the men who work in machine shops, either as employers or employes, prompts us to express the hope that no part of that struggle will be carried on within the shop doors, and that none of the bitterness will be allowed to enter. It is out of place there, and can do nothing but harm to all concerned.

Room for the Topical Questions.

When it was proposed to add the discussion of "Topical Questions" to the proceedings of the American Society of Mechanical Engineers, the proposition met with universal favor amongst the members. It was reasoned that many questions would be brought up that could not be covered in a regular paper, although they might be of equal interest with anything brought out by the more elaborate presentations—in many instances of greater importance to a large proportion of the membership. And it certainly has been proven true, whenever there has been an opportunity to test the matter, that but few papers are discussed with the same general interest as the questions asked off-hand, as it were. But the plan that it has doubtless been thought wisest to pursue, that of sandwiching these questions between the presentation of papers and the adjournment for the session, pretty effectually prevents any consideration of the questions. They are never reached; they grow old, and the expectation and realization in regard to them becomes less and less every year. Since they are not discussed, the query, "Why present them?" becomes more and more pertinent.

We believe it would be in the interests of the society if the discussion of these questions was always made the order of one session, the session being opened with such discussion, and the entire time given to it if found necessary. We believe this would increase the attendance at the meetings, and the interest in them. There are many members who do not have the time or inclination to prepare elaborate papers, but who could give valuable information in the discussion of matters that are apt to be wrongly looked upon as small things.

If giving time, positively, to the purpose named secured the presentation of more plain, practical matter, even to the exclusion of some speculative matter, perhaps, no particular harm would result. Many of the heavy papers are of a kind that cannot be comprehended by more than a few members except after considerable study, and their discussion is frequently as unsatisfactory, except to a limited number. These can be read and studied in the printed transactions when time gives men whose mathematical attainments are not kept polished by every-day use more opportunity. This is not saying anything against these papers, which find an appropriate place in the Transactions of the Society; it is only a plea for a small portion of the time of the meetings for the purpose of bringing out practical points and facts.

In connection with some forgeries which have recently been discovered in this city, attention is called to the fact of the carelessness which allows bonds representing large amounts of money to be so made as to make it an easy matter by a few strokes of a pen to make them appear to represent much more than their actual value. The machinist has helped this matter, so far as it applies to checks, by furnishing a machine which perforates the paper with characters showing the amount called for. No matter whose hands these checks may pass into, they are comparatively safe from alteration, for the perforations would be very difficult, if not impossible to change, and would instantly betray any change which had been made in the written figures. An extension of the idea to other commercial papers of value would seem to be in order. The machinist is not only honest himself, but he stands ready to exert his influence in making others honest by furnishing such little devices as are calculated to make dishonesty awkward and unhandy.

Literary Notes.

A Manual of Marine Engineering, comprising the Designing, Construction, and Working of Marine Machinery. By A. E. Seaton, Lecturer on Marine Engineering to the Royal Naval College, Greenwich, Member of the Institution of Civil Engineers, Member of Council of the Institution of Naval Architects, Member of the Institution of Mechanical Engineers, etc. With Numerous Tables and Illustrations reduced from Working Drawings. Ninth Edition, Thoroughly Revised, and in Part Re-written.

Although this work treats on the design and construction of marine engines according to theoretical principles, it is a thoroughly practical work. The rules and formulas introduced are divested, as far as possible, of complexity, and given in the simplest form attainable, and may be used by any one who designs with some regard to theory, enabling him to carry out a design to agree with the most recent successful practice. Much of the data given has been collected by the author during many years of study and practical work. The former editions of this work have always been regarded as standard works by marine engineers; and the present enlarged and thoroughly revised edition, brought up to the great advances recently made in marine engineering, will be another valuable addition to an engineer's library. It is a reflex of modern practice as well as a record of the history of past successful experience, and those interested in marine engines cannot well afford to be without it. The work is published by D. Van Nostrand Company, 23 Murray and 27 Warren street, New York. Price $5.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(450) H. B. F., Westchester, Pa., writes: We want to cut some speeder wheels of 99 teeth. The circumference of wheels is $5\frac{21}{32}$". Please give me the number of threads to the inch for rotary cutter and method of finding the same. *A.*—The circumference of the wheel expressed decimally is 5.65625"; this divided by 99, the number of teeth, gives .05715" for the pitch, or distance from center to center of the teeth in the wheel. The pitch, or lead of the hob, will be the same, or say, .057", and 1" divided by this gives 17.5, which is the number of threads to the inch.

(451) J. H. W., Dayton, Ohio, writes: We have on our engine a rod $1\frac{7}{16}$-inch diameter, passing through the side of steam chest; this rod is part of the connection between the valve and governor. The movement of the rod is very slight; a part of the time it does not move at all. We wish to know what kind of packing will give the best satisfaction with the least amount of friction, and make a steam-tight joint. *A.*—You do not say whether the rod has a rotary or longitudinal motion. In either case a metallic packing of the right construction will answer your purpose. If you cannot obtain the right kind, use soapstone packing.

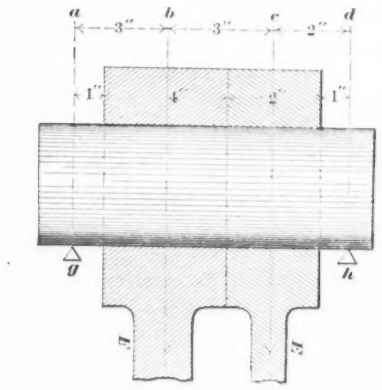
(452) J. F. D., Chicago, asks: Do you consider it any advantage to back off taps in the threads, either by filing or in the lathe? *A.*—It depends upon what the tap is to be used for. Generally speaking it may be said that a tap which is reversed to take it out of the hole at the completion of the tapping should not be backed off, while those which pass through, as is the case with most nut taps used in nut-tapping machines, may be backed off with advantage. A tap which is backed off will not usually cut as steadily nor produce quite as accurate work as one which is left as it comes from the lathe, but for many kinds of work backed off taps are preferred. One must be guided largely by experience and observation in such matters.

(453) G. H. N., South Willington, Conn., writes: I want to bring water from a reservoir 600 feet distant, and 12 feet above where I want my outlet. About what size pipe do I need to enable me to draw 2 gallons of water per minute? *A.*—Your question is not stated plainly enough; it does not state whether 12 feet is the total head or not. Assuming the head is 12 feet, then you will need a pipe $\frac{3}{4}$ inch inside diameter; the pipe must be straight and smooth. If the inside of the pipe is rough, 1 inch inside diameter will be safer to adopt. If the head is greater than 12 feet, then of course a smaller pipe will answer the purpose. 2. Will the water run as fast through a pipe of a true taper, one end being $\frac{1}{2}$ of a square inch in area, the other end 1$\frac{1}{2}$ square inch area, as it will run through a pipe of 1 square inch in area throughout? *A.*—If you mean to extend the taper throughout the whole length of the 600 feet, then the velocity of flow from the tapered pipe will be less than that from the straight pipe.

(454) J. B., Boston, Mass., writes: Please give rule for finding the steam port for an engine 2$\frac{1}{2}$x4$\frac{1}{2}$ inches; number of revolutions, 500 per minute, with a boiler pressure of 180 pounds per square inch. *A.*—It is customary to make the area of each steam port equal to $\frac{1}{10}$ of the area of the piston for a piston speed of 600 feet per minute, and for higher or lower speeds proportionally greater or less; or in other words, for a piston speed of 600 feet per minute, allow $\frac{1}{10}$ of an inch for every square inch of piston area. Hence, the area of a steam port is found by a simple rule of proportion. The piston speed per minute is equal to $2 \times 4.5 \times 500 = 4\,500$ inches = 375 feet. Let x denote the area of the steam port, which is to be allowed for every square inch of piston area; then we have $600 : 375 :: .1 : x$, which gives us 0.0625 of a square inch for every square inch of piston area. Now the area of a piston 2$\frac{1}{2}$ inches diameter is 4.9 square inches; and $4.9 \times .0625 = .30625$ of a square inch for the steam port area. For finding the length of steam port and size of exhaust port, also the proportions of valve, see our issue of May 1, page 5, current volume. Some engineers make the steam port area slightly larger than here given. It will also be noticed that the boiler pressure does not enter into the computation; the same area of steam port is required for lower or higher pressures.

(455) W. I., Portland, Oregon, writes: A case has recently come under my notice in which I would like to have your opinion. In a tannery where I was at work putting up a pump, I saw a blast of steam coming out of the side of the boiler-house, and was informed that it came from the drying-room. This room I found situated about 25 feet from, and 15 feet above the boiler; it contains two stands 30 feet long, covered with wire netting to put wool on; in front of each stand there is a coil of 200 feet of 1-inch pipe, and in front of this coil a blower is placed for the purpose of driving air over the coils and along the stands. The escaping steam I had seen came from these coils; the boiler pressure is from 40 to 60 pounds per square inch. Now I would like to know if this waste of steam could not be avoided by the use of trays and return the condensed steam to the boiler. What size trays will I need? Which make do you think is the best? And how should I arrange the pipes to make the apparatus work successfully? Or is there any other way to get the water back into the boiler? *A.*—If we understand you correctly, steam is allowed to flow through the coils for the purpose of heating the air, which in turn is used for drying the wool; and the steam passing through the coils is allowed to escape into the atmosphere. Under these conditions, we should exhaust the steam into a surface condenser, and then pump the hot water, due to the condensation, back into the boiler. Condensers and pumps are made for this purpose; the size will depend on the amount of steam used; write to any manufacturer of these condensers, and he will send you plans or specifications for the necessary pipe connections. If water is scarce in your locality, so as to prevent you from obtaining a sufficient supply for condensing the steam, we should use a feed-water heater, and use the escaping steam from the coils for heating the feed water.

(456) G. M., New York, writes: Two rods pull on a pin as shown in the figure. The pull on the rod F is 30,000 pounds, and the pull on the rod E is 20,000 pounds. How can the diameter of the pin be determined? *A.*—Draw the center lines $a\,g$ and $d\,h$ through the center of the outer bearings of the pin, and assume that the whole pressure is concentrated on these center lines; also assume that the pull of the rod F is concentrated on its center line b; and the pull of the rod E concentrated on its center line c. For the sake of illustration, let us assume that the width of the eye on the rod F is 4 inches; the width of the eye on the rod E, 2 inches; and the width of each outer bearing, 2 inches. Now, let us compute the pressure on the point h. Under the given conditions, the distance from a to b, will be 3 inches, the force acting along the center line b is 30,000 pounds, and the moment of this force about the point g is equal to $30,000 \times 3 = 90,000$ inch-pounds. Again, the distance from a to c is 6 inches, and the force acting along the center line c is 20,000 pounds, consequently the moment of this force about the point g is equal to $20,000 \times 6 = 120,000$ inch-pounds. The sum of these two moments is equal to $90,000 + 120,000 = 210,000$ inch-pounds. The distance from a to d is 8 inches, which is the leverage with which the reaction at h will act to balance the 210,000 inch-pounds. Therefore $h \times 8$ inches must be equal to 210,000, consequently $h = \frac{210,000}{8} = 26,250$ pounds, which is the pressure at the end h of the pin. The total pull of the two rods is 50,000 pounds, hence the pressure on the end g of the pin must be $50,000 - 26,250 = 23,750$ pounds. The shearing stress is equal to these pressures, hence, the greatest shearing stress is at the end h. If now the pin is to be of uniform diameter throughout, we must make its diameter so as to resist a shearing stress of 26,250 pounds. Allowing 8,300 pounds per square inch to resist this stress, which is about the proper allowance for wrought-iron subjected to varying stress as on bridges, we have $\frac{26,250}{8,500} = 3.08$ square inches of the pin; the corresponding diameter is 2 inches nearly. The total pull of the rods subject the pin to compression sidewise. This compression is usually supposed to be equivalent to a stress uniformly distributed over the projection of the surface on a plane through the axis of the pin. Thus, assuming the diameter of the pin to be 2 inches, and the width of the bearing at h also 2 inches, then the projected area of the pin will be 4 square inches. The pressure at this end we have found to be 26,250 pounds, and $\frac{26,250}{4} = 6,562.5$ pounds compression per square inch of area. Since, for wrought-iron, we may safely allow 12,000 pounds per square inch, we conclude that a pin 2 inches in diameter is large enough for our purpose. From the foregoing it will be seen that, for determining the diameter of the pin, two computations are necessary, one for finding the cross-sectional area of the pin to resist shearing, and the other for the bearing surface to resist compression. 2. In a plate girder with uniformly distributed load, is it necessary to have top and bottom flanges of larger cross-section in the center than at the ends? *A.*—Yes, because the bending moment is greater at the center than at the ends. 3. Is the spacing of the rivets to be closer at the ends than at center? *A.*—Yes, because at the ends the horizontal shearing force is greater than at the center. 4. How can I find the proportions of triangular cast-iron bracket to support a beam with a given load? *A.*—See Elements of Machine Design, by W. C. Unwin.



(457) C. L., Baldwinsville, N. Y., writes: Kindly give me a rule for computing the diameter of a rocker-shaft which is to work under the following conditions: Shaft 3 feet long, having at each end and on the same side a rocker-arm 14 inches long; the power is applied to one of these arms, and a load of 1,000 pounds is attached to the other arm; the shaft makes 200 vibrations per minute. *A.*—The stresses which occur in a shaft subjected to torsion are those of shearing tending to shear off one cross-section from that adjacent to it. Let P denote the load applied to one arm, in the case before us, P=1,000 pounds; let l represent the length of the arm in inches, hence $l = 14$ inches. Now the twisting moment is equal to $P \times l$, or $1,000 \times 14 = 14,000$ inch-pounds. The moment of resistance to torsion, or simply the resisting moment for a cylinder or round shaft, is $.196 \times f \times d^3$, in which f denotes the resistance of the material to shearing; and d denotes the diameter of the shaft in inches. We may consider a rocker shaft to be subjected to a varying stress; under these conditions we may take, for cast-iron, 2,500 pounds per square inch to be a safe working value for f; for wrought-iron, 8,500; and for steel 10,000 pounds per square inch. Since the twisting moment is equal to the resisting moment, we have

$$P \times l = .196 \times f \times d^3 \qquad (1).$$

Now assuming the shaft to be made of cast-iron, and substituting for the symbols their values we have

$$1,000 \times 14 = .196 \times 2,500 \times d^3;$$

from this we obtain

$$\frac{1,000 \times 14}{.196 \times 2,500} = d^3; \quad \text{hence}$$

$$d = \sqrt[3]{\frac{1,000 \times 14}{.196 \times 2,500}} = \sqrt[3]{28.57};$$

which means that the diameter is equal to the cube root of 28.57. To find this cube root we may neglect the decimal fraction .57 and find the cube root of 28 by referring to a table of roots published in any of the engineers' pocket books; the cube root of 28 is 3.03, which is the diameter of the cast-iron shaft in inches. If we take the decimal into account we have for the $\sqrt[3]{28.57} = 3.06$ inches for the diameter of the shaft.

For a wrought-iron shaft we have

$$d = \sqrt[3]{\frac{1,000 \times 14}{.196 \times 8,500}} = \sqrt[3]{8.40} = 2.04$$

inches.

And for a steel shaft we have

$$d = \sqrt[3]{\frac{1,000 \times 14}{.196 \times 10,000}} = \sqrt[3]{7.14} = 1.92$$

inches.

Formula (1) may also be used without any change for finding the length of the arm or the load when the diameter of the shaft is given. To illustrate, a cast-iron shaft is 3 inches in diameter, length of arm is 14 inches; what pressure can be applied to the end of the arm, the pressure acting in a line perpendicular to the center line of arm. Now substituting in formula (1) for the symbols their values we have

$$P \times 14 = .196 \times 2,500 \times 3^3.$$

$$P = \frac{.196 \times 2,500 \times 27}{14} = 945 \text{ lbs.}$$

If the diameter of the shaft had been 3.06 inches we would have obtained 1,000 pounds. Again, what should be the length of the arm on a cast-iron shaft 3 inches diameter to support with safety a load of 1,000 pounds? Substituting for the symbols in formula (1) their values, we have

$$1,000 \times l = .196 \times 2,500 \times 3^3$$

$$l = \frac{.196 \times 2,500 \times 27}{1,000} = 13.23 \text{ inches.}$$

In a similar way we may find the loads and length of arms for wrought-iron and steel shaft, taking care to insert the proper value for f in formula (1). For steady loads the value of f should be taken somewhat higher than given above. For instance, for steady loads on cast-iron shafts we may take 4,000 pounds per square inch for the value of f; for wrought-iron, 12,000; and for steel, 15,000 pounds per square inch. If it is desirable to compute the load acting at the end of the arm which will cause rupture, then the values of f for cast-iron will be 25,000 pounds per square inch; for wrought iron, 50,000; and for steel, 75,000 pounds per square inch. These are, of course average values. It should also be remembered that the length of arm is, in every case, the perpendicular distance from the axis to the line of direction of the force applied to the end of the arm. Here we have not taken into account the length of the shaft, because the length of the twisted rod or shaft does not affect the amount of force required to produce rupture.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Friday morning for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 155 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Send for W. A. Morrison's Prac. Eng'r. (the standard book), enclose $1.00, Box 373, Lowell, Mass.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Wrist-pin Machines. Pedrick & Ayer, Philadelphia, Pa.

Horizontal and Radial Drilling Machine. Pedrick & Ayer, Philadelph'a, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Nov. 20, p. 14 Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Billings & Spencer Co.'s Packer & Boiler Ratchet, & all kinds of Forged Wrenches. S. A. Smith, 23 S. Canal st., Chicago, Western representative.

"Roper's Hand-Books," for engineers and firemen. Send for descriptive catalogue. Address Edward Meeks, publisher, Philadelphia, Pa.

Wanted—One or two gentlemen to purchase president's $70,000 interest in incorporated Mfg. Co.; seller will loan company $100,000 to increase busisiness desired. A. L. B., Carrier 22, Buffalo, N. Y.

25″ / 32″ / 37″ / 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Patent Attorney R. G. DuBois, 715 11th street Washington, D. C., procures 1st-class patents for inventors. Send for pamphlet. Guaranteed by Rand, McNally & Co., of Chicago.

Every pattern maker and wood worker should have a Dutton's clipper grinder, No. 5. Send for circular to Montgomery & Co., 105 Fulton street, New York City.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

The U. S. Patents granted to T. R. Almond for Flexible Metallic Tubing are for sale. Parties desirous to become interested in this valuable invention will please communicate with T. R. Almond, 83 and 85 Washington street, Brooklyn, N. Y.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

"I would not take ten times the price, if I could not get another." W. D. Joslin, see also notice AMERICAN MACHINIST, Oct 23, for review. Hawkins Calculations for Engineers, Firemen and Machinists. $2.50 postpaid, or 10 parts 25 cts. each. Theo. Audel & Co., 91 Liberty st., N. Y. Catalogue.

Just Ready—New Catechism of the Locomotive. The most complete treatise on the construction and operation of the locomotive, by M. N. Forney, M. E. 688 large pages, with 488 engravings, 6 large folding plates, and 20 full-page plates of various styles of locomotives. Sent by mail, free of postage, $3.50. Frederick Keppy, Scientific Book Publisher, Bridgeport, Conn.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES

Ground has been broken for new malleable iron works at Toledo, O.

A roller-mill will be erected at Lexington, Ky., by a stock company.

The Triple Wire Nail Co. has been incorporated at Parkersburg, W. Va.

W. H. Withgott is erecting a new iron and brass foundry at Easton, Md.

The Emerson Machine Co., of Granby, Conn., are to double their capacity.

Hughes & Patterson will erect a rolling-mill 140x120 feet, at Philadelphia, Pa.

A stock company will establish a sewing machine factory at Fredericksburg, Va.

The Wilmington Cotton-mills, Wilmington, N. C., will put in additional machinery.

Lill & Hillsley, of Philadelphia, Penn., will erect a nail factory in Kensington, Ga.

There is some probability that a steel plant will be established at Clarksville, Tenn.

The Batesville Iron Works, Batesville, Ala., will add a foundry to its machine shops.

T. T. Roland & Son are reported as erecting a large plow factory at Tuscumbia, Ala.

A hardware factory will be erected at Wilmington, Del., by the Franklin Edge Tool Co.

Car wheel works are being erected at Jefferson, Texas, by the Lone Star Iron Company.

The Peninsular Car Works of Detroit, Mich., will probably be removed to Seattle, Wash.

The Wheeling & Elm Grove Railway Company at Wheeling W. Va., is to erect repair shops.

A large foundry will be built in Atlanta, Ga., by the Westerland Electric Conduit Company.

The Newnan Cotton Co., Columbus, Ga., is to add $10,000 worth of new machinery to its mill.

The Goshen (Va.) Car and Railway Equipment Co. will build car works plant in that town.

The Tiffany Iron Works, at Tecumseh, Mich., has been incorporated, with a capital of $50,000.

John Kroder will establish a factory for the manufacture of brass goods at Staunton, Va.

The Lone Star Ice Works, of Austin, Texas, will probably establish a foundry and machine shop.

The Beaver Tube Co. has been incorporated at Wheeling, W. Va., with a capital stock of $1,000,000.

The Queen and Crescent Route will remove their car shops from Ludlow, Ky., to Chattanooga, Tenn.

It is reported the nail factory of the Sharon (Pa.) Iron Works may soon be changed into a sheet-mill.

A movement is well under way here for establishing a cotton factory to cost $50,000, at Guyton, Ga.

The Smith Sons & Co. Cotton Gin Works is reported as to enlarge its plant at Birmingham, Ala.

The Moffat Manufacturing Co., of Chester, S. C., is adding an iron foundry to its implement factory.

Gilbert & O'Neil have incorporated the Sheffield Iron Works, to operate their plant at Sheffield, Ala.

The Richmond Ice Machine Company will erect an ice factory and machine works at Manchester, Va.

The Springfield Boiler and Manufacturing Co., at Springfield, Ill., will erect a factory and machine shop.

Smith & Burdette, of Cincinnati, O., are reported as about to establish branch pipe works in Bristol, Tenn.

Philadelphia and Pittsburgh (Pa.) parties are reported as to construct a steel plant in Chattanooga, Tenn.

The Marietta Electric Co., Marietta, Ga., will, it is reported, put new machinery in its electric light plant.

The Tombigbee Iron Works, at Aberdeen, Miss., expect to add car works to their plant within a few months.

The Mossy Creek Foundry and Machine Co., Mossy Creek, Tenn., will put in additional machinery.

The Bessemer Ice Manufacturing and Cold Storage Co., Bessemer, Ala., will put in additional machinery.

The Ruton Manufacturing Co. has been incorporated at San Angelo, Texas, with a capital stock of $30,000.

D. R. Wing & Co. are erecting an addition, 45x100 feet, to their foundry and machine shop at Little Rock, Ark.

It is rumored that boiler and engine works, with a capital stock of $220,000, will be established at Suffolk, Va.

The Alabama Great Southern Railroad Co. (office, Birmingham,) is reported as to build repair shops at Attalla, Ala.

The Cahill Iron Works, Chattanooga, Tenn., is reported as enlarging and increasing the capacity of its iron foundry.

The Congaree Gas and Electric Co., at Columbia, S. C., will, it is reported, put new machinery in its electric light plant.

The St. Joseph Bridge and Boiler Works have been incorporated, at St. Joseph, Mo., with a capital stock of $42,000.

The Gracey-Woodward Iron Co. and others will organize a stock company to construct a steel plant at Clarksville, Tenn.

The Spring City Hardware Company, Spring City, Pa., intend to erect a building 100x50 for the manufacture of hardware.

Franchise has been granted, it is stated, for the erection of an electric light plant and an ice factory, in Lakeland, Fla.

The Brush Electric Light and Power Co., Savannah, Ga., will, it is reported, put new machinery in its electric light plant.

The Rounds & Anderson Foundry Co. has purchased 25 acres of ground in Chicago, on which it will at once erect works.

A stock company will, it is stated, be organized for the purpose of erecting an electric light plant at Danville, Ky.

The Springfield Boiler & Mfg. Co., Springfield, Ills., have erected boiler works, and will build a foundry and machine shop.

The Enterprise Machine Works has put in additional machinery, and will add an iron foundry to its plant at Knoxville, Tenn.

The Briesenick Foundry and Machine Works will, it is stated, rebuild their foundry and machine shops at Brunswick, Ga.

The Chicago Machine Works, an establishment which will employ 500 men when completed, will be erected in Sioux Falls, Dak.

The Corey Car Works will remove from Chicago to Waukegan, ten acres of land on the lake front having been secured for the plant.

The Monument Mills, at Housatonic, Mass., are to put in 20 new looms upon the completion of addition which is now being made.

C. E. McCullough is reported as organizing a stock company to erect an ice factory and an electric light plant in Comanche, Texas.

The Utah Mining and Irrigating Pump Manufacturing Co., with a capital stock of $150,000, has been incorporated at Salt Lake City, Utah.

The Henderson Steel and Manufacturing Company at Birmingham, Ala., has increased its capital to $100,000, and will enlarge its works.

Plans are on foot for boiler and engine works, with capital stock of $220,000, at Suffolk, Va. The Suffolk Land Co. can give information.

It is stated that C. M. Clark, Mr. Seaman, of Wilmington, Del., and others will build a rolling-mill and horseshoe works at Max Meadows, Va.

The Cummings Iron Works at Hammond, Ind., have been purchased by a syndicate, who, it is said, will increase the plant and employ 500 hands.

R. E. Sanford, of Ohio, has purchased the plant of the Laredo Foundry and Machine Co., Laredo, Texas, and will put in new machinery, and operate.

The Princess Iron Co., at Iron Gate, Va., has been organized for the purpose of enlarging an iron furnace, establishing a rolling-mill and other industries.

The Buss Machine Works, of Grand Rapids, Mich., have been offered $20,000 cash and a large tract of land to remove their works to Benton Harbor, Mich.

The Attalla Foundry and Manufacturing Co. has been organized, and will erect a $10,000 chair factory, and a $25,000 foundry and machine shop at Attalla, Ala.

Frank Tyman, E. M. Nettleton, W. A Rinehardt and others have secured a site at Covington, Va., and will erect a foundry and machine shop, and a steam tannery.

Messrs Higgins & Furguson may erect machine shops at Anniston, Ala. In the same city the United States Rolling Stock Co. is said to be increasing its capacity.

The Gordon Cotton Factory, Carrollton, Miss., which has been sold to A. E. Randle, of Washington, D. C., for $90,000, is to be improved by the addition of new machinery.

The East Chicago Steel Works at Hammond, Ind., have been purchased by a Cleveland and Youngstown syndicate, composed of persons largely interested in Brown, Bonnell & Co.

Tomlin & Harris, of Cordele, Ga., have increased the capacity of their planing-mill, erected a foundry and machine shop, and organized the Cordele Machine Shop to operate same.

The Moomaw Automatic Car Coupler Co. has been organized at Pensacola, Fla., with a capital stock of $50,000, for the purpose of manufacturing the patent car coupler of H. E Moomaw.

The Youngstown Iron and Steel Co., of Youngstown, Ohio, are erecting seven additional puddling furnaces at the plant of the Warren Iron and Steel Co., at Warren, which they recently purchased.

It is said that the Southern Iron Company, in consideration of its successful production of basic steel in Chattanooga, Tenn., at a recent trial, has decided to put up a large steel plant at Rockwood, Tenn.

It is stated that the Barlow & Thatcher Spinning Co., of Wilmington, Del., will erect a cotton factory in Piedmont, Ala. The factory will be 106 x144 feet, and an electric light plant is to be put in same.

The Taylor Manufacturing Co., of Chambersburg, Pa., is reported as having closed contract for the removal of its engine works to Bedford City, Va., and a $200,000 stock company is to be organized to operate the plant.

J. M. Blondell, T. E Hambleton, W. A. House, Jr., and others, have incorporated at Baltimore, Md., the Blondell Manufacturing Co., to erect shops for the manufacture of horse, electric and cable street cars. The capital stock is $200,000.

The several land companies operating at Salem, Va., have appropriated $550,000 for the establishment of a $100,000 rolling-mill, a $75,000 muck bar-mill, $50,000 iron works, and $100,000 for the car works which it is desired to have established there.

The Virginia Car Co. has been incorporated, at Buena Vista, Va., with A S. Buford, of Richmond, as president; F. H. Foster, of Glasgow, vice-president, and Charles Conway, of Richmond, secretary, to build car works. The capital stock is to be from $100,000 to $1,000,000

The Fitchburg Machine Works, manufacturers of metal-working machinery (machine tools,) Fitchburg, Mass., have issued an elaborate catalogue of machines built by them. It is printed on excellent paper, and the cuts are fine. Brief descriptions accompany the engravings, and tables of dimensions are given.

The Ashcroft Mfg. Co., 111 Liberty street, New York, are out with a new 1890 catalogue. It is bound with a stiff cover, and contains 104 large, handsomely printed and illustrated pages. The illustrations are of all kinds of boiler appliances, pipe fitters' tools, indicators, injectors, oil cups, cocks, etc. It is a library edition.

There is water-works agitation in Albion, N. Y.; Tacony, Pa; Canaan, N. H.; Seattle, Wash.; Dallas, Texas; Huntington, N. Y.; Sellwood, Ore.; San Antonio, Texas; Belvidere, Ill.; Harriman, Tenn.; Lisbon Falls, Me.; Franklin, N. H.; Groveton, N. H.; Unionville, Conn.; South Berwick, Me.; Halifax, N. S.; Lima, O.; Boise City, Idaho; Perth Amboy, N. J.

An iron company contemplates the erection of an entire new plant at Lonsdale, Pa., to occupy seven or eight acres. The main building is to be 90x20 feet., with a machine shop 40x80 feet. They are engaged in the manufacture of plumbers' supplies. A committee has been appointed to confer with the company. It is understood they have offers from several other towns.

The Consolidated Safety Valve Co., 111 Liberty street, New York, has issued a comprehensive catalogue relating entirely to pop safety valves. There is a preface addressed to steam users that should be read by every one having to do with boilers. The company make a variety of pop safety valves suitable for different conditions, which are illustrated and described in the catalogue. It is bound in a manner that will insure its being preserved.

The Stiles & Parker Press Co., Middletown, Conn., and 203-207 Centre street, New York, has issued a new and enlarged catalogue of presses, drop hammers, shears, dies and special machinery. The catalogue is finely printed, bound in cloth, and very completely illustrated with excellent cuts. The formation and operation of the dies are shown by illustration and description, and the description of machines is clear and concise. The catalogue should have a place in engineer's and mechanic's libraries, as well as in those of manufacturers.

An English Railroad Accident.

About two o'clock on Tuesday morning the little station of Norton Fitz Warren, about two miles below Taunton, on the Great Western line, was the scene of an accident by which ten people were killed and as many injured. The train to which the accident occurred was a special, composed of two composite carriages and a brake van, which was run from Plymouth for the convenience of passengers who had arrived from Capetown at seven o'clock the previous night by the Norham Castle, and who were anxious to get on to London and elsewhere. The train passed Exeter at 1.20, traveling at the rate of about fifty miles an hour, and in another quarter of an hour Wellington was reached. Shortly before this, however, a goods train from Taunton to Exeter was shunted from the down line at Norton to the up line, in order to allow the down mail to pass through. The up line was blocked as the special approached; but this fact seems to have entirely escaped the attention of the signalman, George Rice, who signaled, "All clear." The special was traveling at about fifty miles an hour when it dashed into the stationary goods train. The engines were much damaged, whilst the foremost carriage of the special and several of the laden trucks of the goods train were thrown on the top, a mixed mass. The tender of the passenger engine was forced through the first three compartments of the carriage next to it. Of the occupants of this carriage ten were killed. The escape of the driver and stoker is remarkable. Both these men, Scott and Thomas, the former of whom has been in three previous collisions, are now alive and been removed to their homes in Exeter, but their injuries are very severe. Scott was hurled backwards into the train, and eventually got away through a carriage door. The driver and stoker of the goods train, seeing the special rushing down upon them, jumped off just in time to save their lives.—*London Engineering.*

Sketches of an Apprenticeship.

BY W. S. ROGERS.

XI.

Speaking of runaway apprentices and those chaps who go through a three years' course in about six months, reminds me that I have never yet seen a runaway apprentice that ever made a success as foreman or superintendent, although I have seen a good many of them try it, and two or three of them several times.

The cub who goes through his term with his eyes wide open, not only learns all the rudiments of his trade, but he generally gathers in a good deal of the business talent of the Old Man in the shop, just from association.

An example of how some youngsters learn real fast, or at least think they do, came under my observation recently. A young fellow obtained a place and went to work in a shop, assuming the usual routine duties of handling castings, sweeping shop, swinging the sledge, etc., and *learning*. At the end of a few weeks the old man noticed that the only thing the young man had learned was to do the Greek statue act of standing with his arms folded and watching the wheels go round; so he quietly ceased to exist in that shop. But two days later he applied for work in another shop, recommending himself as a first-class machinist, and demanding high-class wages.

Well, they gave him a lathe, and the foreman gave him some rough cast-iron collars to be drilled, bored and reamed. He drilled them all first, then he bored them, then he used the reamer; while turning the tail-stock handle he got the spindle screwed clear out. Turning the handle the other way didn't make it go back; trying to push it with both hands didn't help either, so he got a sledge and *drove* it back. He is not working there now, but if I find him some time in the future acting as instructor in some mechanical college somewhere, I won't be surprised.

These runaway cubs and "rapid learners" do get into high places sometimes through pity, cheek, luck and other causes, but they don't last, and go up like the sturdy young cub who "roughs it" through his three years' course.

I have often thought it would be a good thing to have a national law calling for a properly drawn-up contract between every apprentice and his employer, compelling the apprentice to serve his allotted time, or forfeit a certain percentage of his wages. Also compelling the employer to teach his apprentice everything necessary about each branch of his trade, so as to make him a worthy journeyman, or forfeit a sum equal to three or four times the amount earned by the apprentice during his years of "servitude."

This method and plan would not be acceptable to the "greedy" capitalist, or the walking delegate, but, as the former is generally a man doing business on borrowed capital, and the latter is making a living on borrowed brains, their objections would be considered as approval. At any rate, such or similar plans in vogue would give us mechanics when we advertise for them, and we would not hear the present everlasting query from every quarter of our country—"Where can we get some good machinists?"

For Prompt Freight Delivery.

A meeting of the general officers of the West Shore, Delaware, Lackawanna & Western, New York, Lake Erie & Western, Pennsylvania, New York, Susquehanna & Western, Central Railroad of New Jersey, Lehigh Valley, New York & Long Branch and Philadelphia & Reading Railroad Companies was held at Jersey City, on Wednesday, November 19, to consider as to the best methods to secure the prompt handling of freight cars at the various stations on the lines of the roads in the State of New Jersey. It has been found that the lack of a limit as to the time freight cars can be held for unloading and loading the same has resulted in serious inconvenience and detriment to the business of consignees who are prompt in handling their freight, as the accumulation of cars in delivery yards has prevented the placing of cars for those who are prompt in removing their freight. In order to overcome this delay it was resolved to take steps looking to the organization of a car service association to cover the State of New Jersey, similar in its character to such associations as have been organized elsewhere throughout the country.

A charge for demurrage for detention over 48 hours after cars have been placed in delivery yards will be made. The organization expects to commence operations on the first of January next. The association will be in charge of a manager independent of either of the railroad companies.

The effect of such organizations prevents discrimination in favor of one consignee as against another, and enables consignees to rely upon the prompt delivery of freight as forwarded to them under their own directions.

It also removes causes of friction between the several railroad companies that are frequently raised in the transaction of competitive business.

The result of the workings of these associations elsewhere has proved of great advantage to both the consignees and the rail-

road companies, and will undoubtedly be advantageous to all communities, particularly to those where the freighting is large and increasing. This seems to us to be an unusually meritorious and commendable scheme. Its operation will be beneficial both to shippers, consignees, and the railroad companies. We hope the association will be successfully organized, and that all the railroads will concur in its action.—Jersey City *Evening Journal.*

An Open Letter.

To the Engineers of the United States:

Your associations are meeting with success and prosperity that is gratifying to every well-wisher of the engineers. The objects for which they are formed are admirable. They educate, instruct, and bring together many minds whereby you exchange opinions, which result to the benefit of all who are seeking to be enlightened. Now, has it ever occurred to you that while in your prosperity you should prepare for the welfare of those who should be so unfortunate as to lose a limb, or meet with an accident which would prevent them from earning their living? Why not build a suitable home for the unfortunate? Have it centrally located, and founded on the broadest of principles—a home that would welcome every engineer who has had charge of an engine for a year or more, as you may decide. It is not necessary to go into details here. This is merely a suggestion on my part, and pardon me if I intrude. No doubt every manufacturer and merchant of steam appliances would be pleased to contribute to such a worthy object, and the contributions which would come from your associations would build a comfortable and suitable home. Now, gentlemen, in your meetings, debate, deliberate, and, what is more, act on this question. It is for you to decide, and thousands will wish you success.

Yours respectfully,

ALFRED B. JENKINS.

New York, November 25th, 1890.

Force, Motion and Work.

BY PEDRO.

NINETEENTH PAPER.

DYNAMICS OF VARIABLE MOTION IN GENERAL.

The dynamic laws that have been formulated in the foregoing papers were, as frequently stated, only intended for uniform and for uniformly accelerated and retarded motion. The question now arises whether those formulas are applicable in a more general case, or whether they must be modified to adapt them to a variable motion in general. In studying this question let us first examine the acceleration.

Let us assume a motion diagram, Fig. 59, in which the curve $A\ D\ E$ represents, generally, the velocity line of the motion. Suppose the velocity to be known at the two points D and E, and to be V_1 and V_2, corresponding to the time of motion t_1 and t_2. During the interval of time $t = t_2 - t_1$, the velocity will have increased an amount represented by $F\ E = V_2 - V_1$. Now, by Equation 27 (VI.) fifth paper, we should have the acceleration

$$73.\ldots\ldots\ldots a = \frac{V_2 - V_1}{t} = \frac{V_2 - V_1}{t_2 - t_1}.$$

But by inspection of the diagram, Fig. 59, we see at once that this equation does not give the true value of a, for if it did, the velocity line would have to be a straight line passing through the two points D and E, as shown by the dotted line; see also Fig. 6, fifth paper. The equation gives a sort of an average increment of the velocity for the time t, for the velocity acquired in the time t will be $V_2 - V_1$, whether the increment follows the straight line $D\ E$ or the curve $D\ E$. The *average acceleration*, however, does not give the true *rate* of increase of the velocity at any given time, for it is evident from Fig. 59 that at the point D the rate of increase is slower if it follows the curve than it would be if the straight line was followed, while at the point E the curve gives a more rapid increase than the straight line $D\ E$.

By taking a smaller portion of the velocity line between the points D and E, in other words, by reducing the interval of time t, the difference between the average and the actual acceleration may be reduced, because the curve and the straight line $D\ E$ will approach each other, and have more nearly the same direction as t becomes smaller and smaller. When t is infinitely small, then the curve $D\ E$ and the straight line $D\ E$ practically coincide between the points D and E, in which case Equation 73 gives the

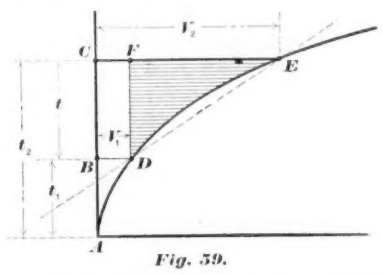


Fig. 59.

true as well as the average acceleration, since there is no appreciable difference between the two. Fig. 60 represents the motion much exaggerated, the minute difference of time $t_2 - t_1$ being represented by $d\ t$; also the difference of the velocities, $V_2 - V_1 = d\ V$. Substituting these values in Equation 73, we get

$$74.\ldots\ldots\ldots a = \frac{d\ V}{d\ t}.$$

This is the differential equation for the acceleration, which seems, generally, to be equal to the differential coefficient of the velocity as the dependent, and the time as the independent variable. This may be regarded as being the acceleration at the time t_1 or t_2, or intermediate values, since a is practically constant between the points D and E, Fig. 60.

We also see in the small triangle $F\ E\ D$, Fig. 60, that the expression $\frac{d\ V}{d\ t}$ or $\frac{F\ E}{F\ D}$ is the tangent of the angle that the straight line $D\ E$ makes with the *time axis* $A\ B$, or the cotangent of the angle $D\ G\ A$, with the velocity axis. The line $D\ G$ is tangent to the curve at the point represented by the time t, since D and E are supposed to be infinitely near each other. Hence, the rate of increase of the velocity is always equal to the cotangent of the angle that the tangent line makes with the velocity axis $A\ G$.

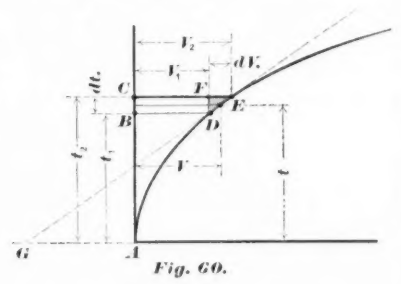


Fig. 60.

From Equation 74 we obtain directly the differential equation for the velocity, which is

$$75.\ldots\ldots\ldots d\ V = a\ d\ t, \text{ or}$$

$$76.\ldots\ldots\ldots d\ V = \left(\frac{d\ V}{d\ t}\right) d\ t.$$

The differential equation for the space passed over by the body is obtained from the area $B\ D\ E\ C$, described by the generatrix V, in the differential time $d\ t$, hence

$$77.\ldots\ldots\ldots d\ s = V\ d\ t.$$

From Equations 74 and 77 we get

$$78.\ldots\ldots\ldots a = \frac{V\ d\ V}{d\ s}.$$

Again, by differentiating Equation 77, we have

$$d^2\ s = d\ V\ d\ t;$$

dividing this by $d\ t^2$, we get

$$\frac{d^2\ s}{d\ t^2} = \frac{d\ V}{d\ t},$$

which, combined with Equation 74, gives

$$79.\ldots\ldots\ldots a = \frac{d^2\ s}{d\ t^2}.$$

That is, the acceleration is also equal to the second differential coefficient of the space with respect to the time.

Let us collect the different equations of the same kind under one number for convenience of reference, then we get from Equations 77, 78 and 79

$$80\begin{cases} \text{I}.\ldots\ldots\ldots\ldots s = \int V\ d\ t. \\ \text{II}.\ldots\ldots\ldots\ldots s = \int\int a\ d\ t^2 \\ \text{III}.\ldots\ldots\ldots\ldots s = \int \frac{V\ d\ V}{a} \end{cases}$$

From Equations 75, 77 and 78 we get

$$81\begin{cases} \text{I}\ \ldots\ldots\ \ldots\ldots\ V = \frac{d\ s}{d\ t} \\ \text{II}.\ldots\ldots\ldots\ldots V = a\left(\frac{d\ s}{d\ V}\right) \\ \text{III}.\ldots\ldots\ldots\ V = \int a\ d\ t \end{cases}$$

Equations 75, 77 and 79 give us

$$82\begin{cases} \text{I}.\ldots\ldots\ldots\ldots t = \int \frac{d\ V}{a} \\ \text{II}.\ldots\ldots\ldots\ t = \int \frac{d\ s}{V} \\ \text{III}.\ldots\ldots\ldots\ldots t = \int \left(\frac{d^2\ s}{d\ t^2}\right)\frac{d\ t}{a} \end{cases}$$

Collecting 74, 78 and 79, we have

$$83\begin{cases} \text{I}.\ldots\ldots\ldots\ a = \frac{d\ V}{d\ t} \\ \text{II}.\ldots\ldots\ldots\ a = \frac{V\ d\ V}{d\ s} \\ \text{III}.\ldots\ldots\ldots\ a = \frac{d^2\ s}{d\ t^2} \end{cases}$$

To compare these equations with those previously deduced, let us assume a motion

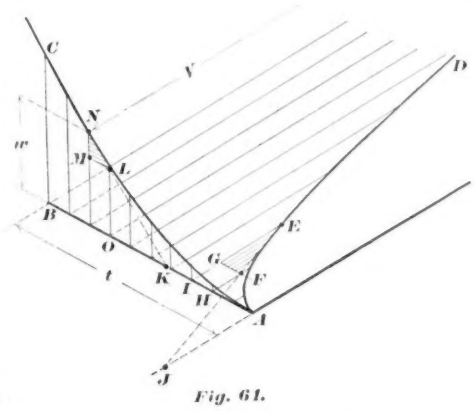


Fig. 61.

diagram, in which the velocity line is a parabola, whose equation is

$$84.\ldots\ldots\ldots V = V_1\ t^2,$$

in which V_1 is the velocity acquired by the body in one minute. From this equation we get by differentiation

$$\frac{d\ V}{d\ t} = 2\ V_1\ t,$$

which is the acceleration according to Equation 83 (I.), that is, the rate at which the velocity increases at any given time t is

$$85.\ldots\ldots\ldots a = 2\ V_1\ t.$$

Substituting the value of V from Equation 84 in 80 (I.), and integrating, we get

$$86.\ldots\ldots\ldots s = V_1 \int_a^t t^2\ d\ t. = \frac{V_1\ t^3}{3}$$

The time of motion we get from Equations 84 and 86

$$87.\ldots\ldots\ldots t = \sqrt{\frac{V}{V_1}}$$

$$88.\ldots\ldots\ldots t = \sqrt[3]{\frac{3\ s}{V_1}}$$

From these two equations we get

$$89.\ldots\ldots\ldots V = \sqrt[3]{9\ V_1\ s^2}$$

Now, comparing Equation 86 with 12 (II.), fourth paper; 84 and 89 with 13 (III.) and 13 (II.); 87 and 88 with 14 (I.) and 14 (III.); and 85 with 15, we see that the equations above are materially different from those of a uniformly accelerated motion. We conclude, therefore, that the formulas for the motions of the previous papers are strictly true, only for the particular kind of a motion for which they have been given. For the general formulas that will represent any motion whatever we must refer to Equations 80 to 83.

Now, is the same thing true in regard to force and work?

To get a formula which would give us a measure of the static force required to move a free body, we have taken the average effect produced in *one minute* (eleventh and twelfth papers). In a strictly general sense, however, the measure of the force is the *rate* at which the effect is produced, and this rate is, as in the eleventh paper, the product of the weight of the body moved, and the *rate* at which space is generated by the static force at the given instant.

To make this point clear, let us refer to Fig. 60. Here the body moves at the end of the time t_1 with the velocity V_1, and if no force acts upon the body after the time t_1, then the space generated *by the body* during the time $d\ t$ is represented by the area $B\ C\ F\ D$. This area is generated with a uniform velocity V_1, as we have seen in the fifteenth paper, and the first law of motion. But if a force still acts upon the body after the time t_1, then an additional space will be passed over during the same time, $d\ t$, and this is represented by the area $F\ D\ E$. This is the space generated *by the force*, and has no intimate connection with the space, $B\ C\ F\ D$, generated *by the body*. The latter is the same, whether the force acts after the time t_1 or not. The space generated by the body is due to force stored in it at some previous time. The space generated by the force is due to the present action of the force without regard to its influence in the past.

This idea may be further illustrated by a man standing on the rear end of a moving railway coach. As long as he stands still upon the car he moves with it at the same uniform speed that the car moves, by virtue of the force previously stored in him—the dynamic force of the man. But if he now walks to the forward end of the car he passes over an additional space in a given time, and this additional space is due to the force acting upon or within the man at the instant the rate of the space passed over was increased. The space *passed over* is the sum of the space generated by the body, and that generated by the force.

It may be evident, now, that we must look for a general measure of force in the space generated by the force itself. This space is represented in Fig. 60 by the small triangle $F\ D\ E$, the hypothenuse $D\ E$ being practically a straight line when the time $d\ t$ is taken infinitely small. The increment of the velocity corresponding to this time is $F\ E = d\ V$. We have, then, the space or area

$$F\ D\ E = \frac{d\ V d\ t}{2}$$

Multiplying this by the weight of the body we get the effect produced in the small time $d\ t$, as in Equation 35, eleventh paper, viz.,

$$90.\ldots\ldots\ldots e = \frac{w\ d\ V\ d\ t}{2}$$

Now the rate at which this effect is produced $\left(\frac{e}{d\ t}\right)$ is the absolute dynamic force, and by reducing the space to gravity units by dividing by $\frac{1}{2}\ g$, we get for the dynamic force generated in the differential time $d\ t$,

$$91.\ldots\ldots\ldots d\ F = \frac{w\ d\ V}{g}$$

Now the measure of the accelerating force is the rate at which the dynamic force is generated (eleventh and fifteenth papers), hence:

$$92.\ldots\ldots\ldots f = \frac{d\ F}{d\ t} = \frac{w\ d\ V}{g\ d\ t}$$

Combining this equation with 83 (I.) we have:

$$93.\ldots\ldots\ldots f = \frac{w\ a}{g}$$

This equation, we see, is the same as 46, twelfth paper, but there is this difference, viz., for a uniformly accelerated or retarded motion the acceleration or retardation a is constant, while for a variable motion in general it is variable, and must be determined, for any given instant, by Equation 83.

From Equation 91 we get the general expression for the dynamic force, which is:

$$94\ldots\ldots F = \frac{w}{g}\int d\ V = \frac{w\ (V_2 - V_1)}{g}$$

This is of the same form as found in Equation 48 (I.) when the lower limit is zero.

Taking the example of the parabolic motion previously assumed, and substituting the value of a, as found in Equation 85, in 93, we get for the accelerating force at any time of the motion:

$$95.\ldots\ldots\ldots f = \frac{2\ w\ V_1\ t}{g}$$

Also, by combining Equations 94 and 84,

and integrating between the limits zero and V, we get the dynamic force :

$$96 \ldots\ldots\ldots\ldots F = \frac{w}{g} V = \frac{w}{g} V_1 t^2$$

The force-motion diagram for this case is shown in Fig. 61. The parabolic curve $A\ E\ D$ is the velocity line, and $A\ N\ C$ is the dynamic force line. The acceleration for any given time can be found graphically by drawing a tangent $E\ J$ to the velocity line, as at E—the three-minute point in this case. From the point F, where this tangent intersects the preceding minute line, $H\ F$, draw the line $F\ G$ parallel to the time axis $A\ B$, then will the distance $G\ E$, thus found, represent the true acceleration for that instant.

In the same manner the accelerating force may be found by drawing a tangent $N\ K$ to the dynamic force line at the point representing the given time—eight minutes in this case. $M\ L$, drawn through the intersection of $O\ L$ and $N\ K$, and parallel to $A\ B$, will give $N\ M$ for the accelerating force at this instant. Compare Fig. 61 with Fig. 49, fifteenth paper.

The general expression for the work is found by combining Equations 92 and 80 (I.), which give :

$$97 \ldots\ldots\ldots W = \frac{w}{g} \int V\, d\ V = \frac{w}{2g} V^2$$

This is the same as found in the seventeenth paper. As far as work is concerned, therefore, this formula is the same, to whatever kind of a motion it may be applied. If Equation 97 is integrated between the more general limits, we get :

$$98 \ldots\ldots\ldots\ldots W = \frac{w}{2g} (V_2 - V_1)$$

Here we see that the work expended upon a free body in setting it in motion depends only upon the initial and final velocities; that it is not affected by the intermediate changes of velocity, whatever they may be.

In a recent lecture at Cooper Institute, on the English workingmen, Mr. Lincoln, the speaker, reasoned that from the four bloods in the veins of English workingmen—the ancient Celt, the Anglo-Saxon, the Danish and the Norman—he had inherited patience and endurance, reason and common sense, love of adventure and desire for gain, and a romantic disposition that led him to better his condition.

In the middle of the fourteenth century the plague swept away one-third of the population of England, and then began the first move in the emancipation of English workingmen. Previous to this they were not permitted to move from place to place as they desired; at this time they secured this right, and the scarcity of labor enabled them to secure better pay. At the end of the fourteenth century "the good old times of English labor" began, and for 150 years workingmen lived better than ever before or since. Then Henry VIII. swept away this prosperity by debasing the currency and confiscating the monasteries, which were asylums for old and sick workingmen. At the present time, the lecturer said, the condition of the workingmen in London was extremely bad.

A big legal fight is in prospect on the air-brake question. The New York Air-brake Co. have recently brought out a brake which has been illustrated and described quite generally by the railroad journals, and which is claimed by the Westinghouse Company to be practically an appropriation of their entire apparatus, and suits for injunction and damages have been brought.

It has been quite definitely settled that a lineman, while working over some wires in New York, died without the interposition of the electric current. The publication of the fact caused considerable excitement amongst those who are in the habit of laying about everything that occurs to electricity.

A pleasant incident of one of the sessions of the engineers at Richmond was the confidence expressed in the steam tables of Mr. Charles T. Porter. The wish that these tables should be the ones used by the society seemed to be unanimous.

On appeal to the courts, a receiver has been appointed for the Decatur, Chesapeake and New Orleans Railroad. The charges were that the company was insolvent, and had sold out to another company that was largely in debt.

The fast mail train on the Illinois Central was wrecked at Kankakee recently. The engineer, Mr. Barker, lost a leg and an arm, and the fireman was killed. Cause, a misplaced switch.

English capitalists are, it is said, proposing to establish plants for building large guns in this country, if they are given the encouragement of receiving large orders.

The first move made by the Glass Trust is raising the price of window glass 5 per cent. This is thought to be only the beginning of the advance.

Machinists' Supplies and Iron.

NEW YORK, Nov. 29, 1890.

Iron—American Pig—No change of importance has taken place since our last report. All the well-known brands are closely absorbed by the regular demand at full prices, though occasional lots of the lesser known brands are sold at considerable concession. Buyers remain conservative, and show very little disposition to buy beyond present needs.

We quote No. 1 Foundry, standard Northern brands, $17 to $18; No. 2, $16 to $16.50; Grey Forge, $15 to $15.50; Southern brands, No. 1 Foundry, $16.50 to $17; No. 2, $15.75 to $16.

Scotch Pig—The demand has continued moderate, and trading confined to small lots.

We quote Coltness, $24.50; Dalmellington, $22 to $22.50, and Eglinton, $20.50.

Copper—The situation presents no new features, the trading having been moderate and confined to small lots. Nominal price of Lake remains at 17c. for prompt and near deliveries, but there are sales at 16⅛c. to 16⅜c.

We quote casting brands, 14c. to 14¼c.; Arizona, 15c. to 15¼c.

Lead—The market has been dull and quiet, with very little trading going on. Prices are at 4.75c. to 4.85c. for prompt deliveries.

Spelter—The demand for Western is moderate. Values show no change of importance.

We quote ordinary brands of Western at 6c. to 6¼c.; choice, 6⅛c. to 6¾c.; refined, 7¾c. to 8c.; Silesian, 7⅜c. to 7½c.

Tin—Prices have fallen considerably in London, the result being some weakness here, with little business transacted. Prices are at 20½c. to 20⅝c.

Antimony—The market has ruled steady and quiet.

We quote Hallett's, 17⅛c.; Cookson's, 19⅛c. to 19¾c.

Lard Oil—The market is quiet, and prices have declined slightly, quotations now being 49c. to 50c. for Prime.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Pattern makers, machinists and molders Inquire, Dustin-Hubbard Mfg. Co., Fort Payne, Ala.

Foreman wanted for machine shop, to handle about 75 machinists to advantage. Address B 2, AMERICAN MACHINIST

Wanted—A number of good machinists on new and repair work. State age, exp., refs., and wages expected. Beall Machine Shop, Cumberland, Md.

Wanted—First-class man, capable of tempering fine tools. Chester Twist Drill and Tool Company, Chester, Pa.

Wanted—Position, supt. or foreman open for engagement, good manager and a pusher; mach. tools, mill and engine; age 35. Refs., Box 12, AM. MACH.

Situation wanted by mech. draftsman, mathematician, and practical, thorough machinist; city New York or Brooklyn. Mech. Draftsman, AM. MACH.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Salesman, who can handle a line of high grade automatic engines, from 5 to 40 H. P., on commission; also, agents wanted in the different cities. Address Box 9, AMERICAN MACHINIST.

Wanted—A competent man as foreman in a machine shop, must be a good draftsman and capable of handling men, also in getting out 1st-class work promptly. Address M. E. B., AMERICAN MACHINIST.

Wanted—A draftsman well acquainted with machine tool work and jigs. Address, stating age, nationality, experience, and salary expected, Feracute Machine Co., Bridgeton, New Jersey.

Wanted—A foreman who is capable of handling about 40 men on new work and jobbing. Good salary to a good man; state age, and give references. Works located in a New England city. Address Box 11, AMERICAN MACHINIST.

Superintendent or Manager—Party well qualified by long experience and familiarity with the details of all depts., desires to effect a change by Jan., or will establish a profitable business anywhere. "Steam Pumps," P.O. Box 92, Station W., Brooklyn.

Wanted—Immediately, 5 good machinists for machine shop. Tool and floor hands, and two men capable of taking machinery out, and erecting same when built. Apply or address at once to Kenney & Co., Scottdale, Pa.

An educated, experienced mechanical engineer, with shop practice, desires a position; familiar with steel works, blast furnaces, modern tool designs, steam plants, and simple methods of office and cost accounts; ample references of ability and steadiness. Address Safe Practice, AM. MACH.

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BEST HAMMERS IN THE WORLD RUN BY BELT

OVER 1500 IN USE.

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Our FORCES heat irons fast enough to keep Hammers and Men fully employed. Send for Catalogue and Prices.

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BY WALTER FITZGERALD.

3d Edition, 18mo, Cloth, 75 Cents.

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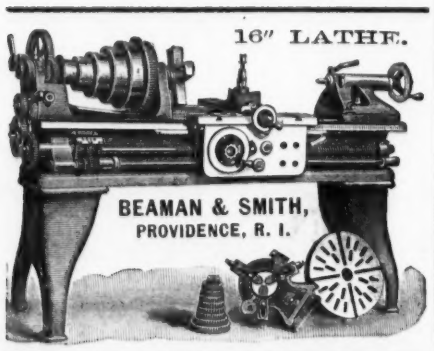

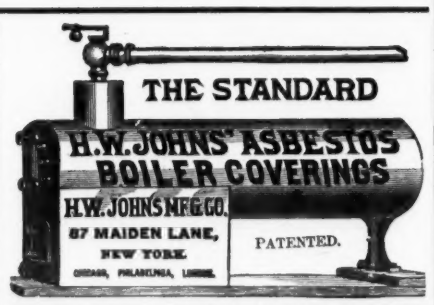

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Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

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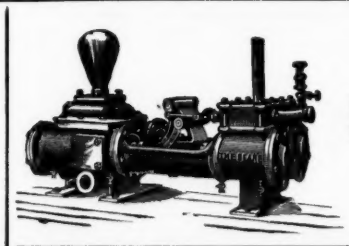

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CRESCENT SELF-HARDENED STEEL

Is warranted to do as much work as any foreign steel, and costs less.

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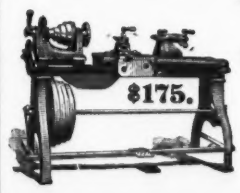

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Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
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Round, square, and hexagon bars for pump, piston rods, bolts and screws. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Spring wire.

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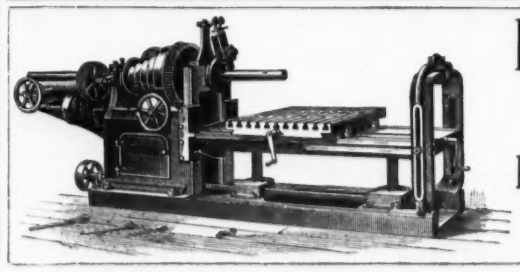
NO MACHINE SHOP CAN AFFORD TO BE WITHOUT

NICHOLSON'S EXPANDING MANDRELS.

Write for latest Circular. W. H. NICHOLSON & CO., Wilkes-Barre, Pa.



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Mechanical engineer, possessing theoretical knowledge, several years varied experience, business and executive ability, desires responsible position. S., P. O. Box 321, Chicago, Ill.

Superintendent—A competent mechanical engineer with good record, now in charge of large works, wants to make a change. Good manager of men; well acquainted with best shop practices and systems. Experienced in marine and stationary engines and boilers, and general machine work. Address A. H. R, 144, AMERICAN MACHINIST.

Wanted—A company, extensively engaged in the manufacture of steam boilers for large power plants, is desirous of securing the services of several experienced salesmen, possessing a practical knowledge of steam, and good business qualifications. Address with references and full particulars, Manufacturer, BOX 10, AMERICAN MACHINIST.

Wanted—An active man as superintendent, by a manufacturing company in railway line; must be thoroughly familiar with the best practice in manufacturing, both in wood and iron; the plant is of good size, modern, splendidly equipped, and the business growing very rapidly; the opportunity is a rare one for a first-class man. Address J., AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d-hd lathes & planers. S M York, Clev'd, O.

For Sale—Corliss Engine Drawings. O., AM. MACH.

Agents wanted for Western Machinist, Cleveland, O.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Wanted—Six or seven-foot second-hand vertical boring mill; 48"x10 foot second-hand planer; 36"x 10 foot second-hand lathe; and other machine tools. Address Suligut, AMERICAN MACHINIST.

For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Wanted—Engineers to write for Catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Wanted to Buy—Pratt & Whitney No. 1 screw machine; Pratt & Whitney No. 1 six-spindle gang drill; Pratt & Whitney No. 2 power milling machine, with sliding tail stock; Pratt & Whitney 13-inch engine lathe; 10-inch hand lathe; quote net cash prices. Lefever Arms Co., Syracuse, N. Y.

Wanted—Some manufacturer or capitalist to join an experienced boiler maker, lately superintendent of a large establishment, who is prepared to furnish highest references as to ability and character, in putting on the market two styles of patent firebox, which are adapted for use in either new or old locomotive or stationary boilers, and which have especial advantages of utility and cheapness. Address W. Malam, 142 Oak street, Paterson, N. J.

Correspondence solicited with parties having light machinery to build. Address D. T. C., AM. MACH.

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BRASS, STEEL or IRON
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WRITE FOR PRICES.
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FOR EVERY VARIETY OF WORK.

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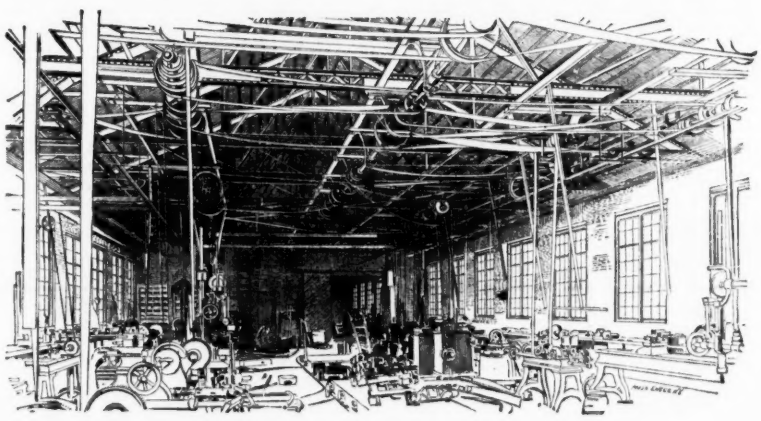
The above cut is taken direct from a photograph of an iron roof built by us for The C. W. Hunt Co., at West New Brighton, Staten Island, for a Machine Shop. The building is 42 feet in width by 202 feet in length, the trusses being placed 10 feet apart, connected by iron purlins and covered with slate. Notice that the roof is arranged to carry shafting at any point on the lower chord, which is considerable of a novelty in an iron roof.
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No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	3/8	$ .35	8	2	$1.10
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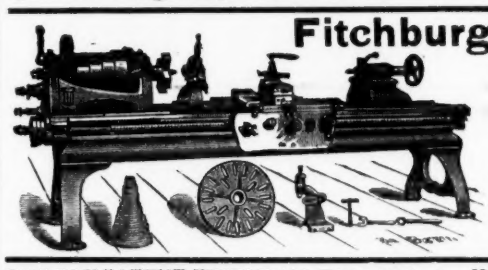
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Scroll Saws, Circular Saws, Lathes Mortisers. Catalogue Free of all our Machinery.
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BUFFALO FORGE CO., BUFFALO, N. Y.

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American and European Patents obtained at equitable rates. *Special Facilities for Sale of Foreign Patents through our London House. A good invention is worth as much in Great Britain as in the U. S.* Competent draftsmen employed on premises. We refer to well-known men in the machine trades for whom we have done business. Send for Circular.

THE INDISPENSABLE LATHE DOG.
One Set of 3 does the work of 12 common dogs.
No. 1, 1/4" to 1 1/4"; No. 2, 1/4" to 2 1/4"; No. 3, 1" to 3 1/4".
$7.50 Per Set.
These dogs can be attached after the work is centered in the Lathe.
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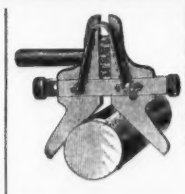
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IN THE MARKET.
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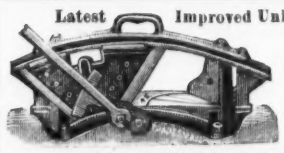
Metal guaranteed to be equal in quality to the best metal manufactured by any other process.
Prices on sheets, wire, tubes or castings, given upon application.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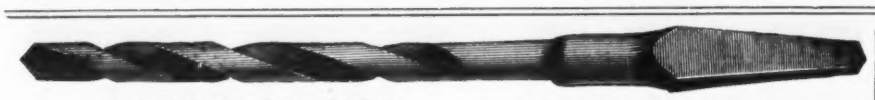

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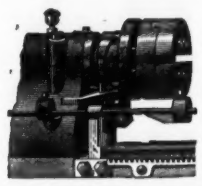

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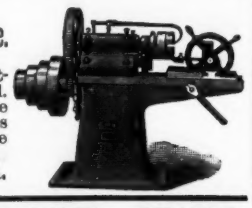

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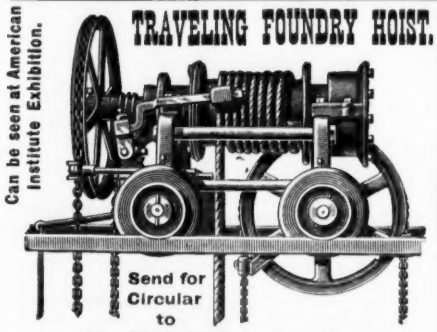

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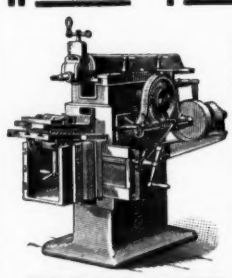

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Two New Engine Lathes, 26" Swing, 12 foot Bed.
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They are the only books of the kind ever published in this country, and they are so plain that any engineer or fireman that can read can easily understand them.

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PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND TWIST DRILL GAUGE.

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POP SAFETY VALVES,

For Stationary, Marine and Locomotive Boilers.

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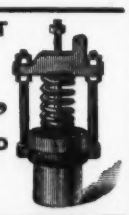

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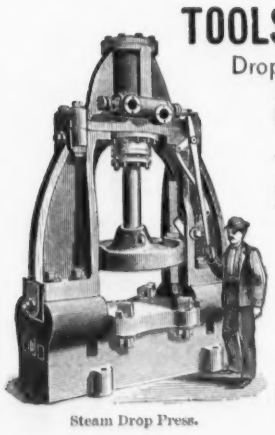

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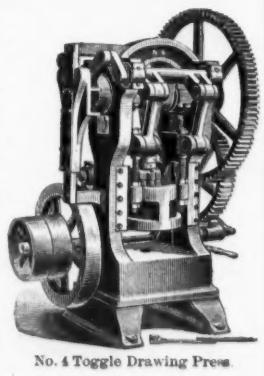

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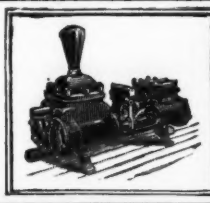

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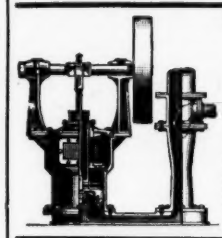

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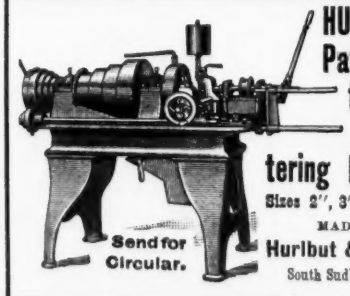

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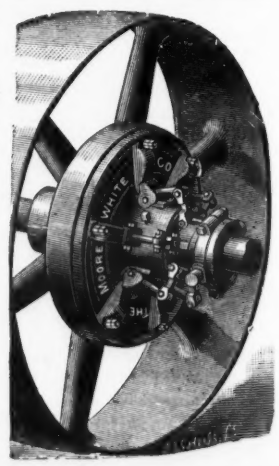

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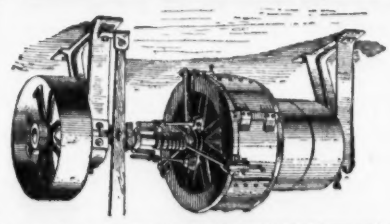

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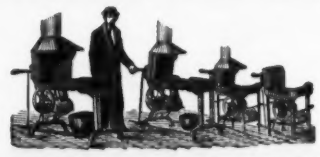

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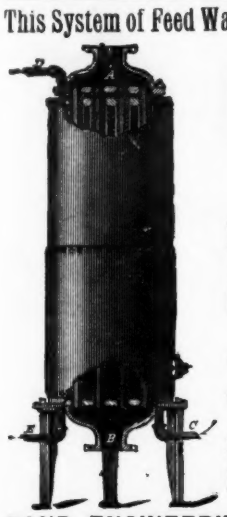

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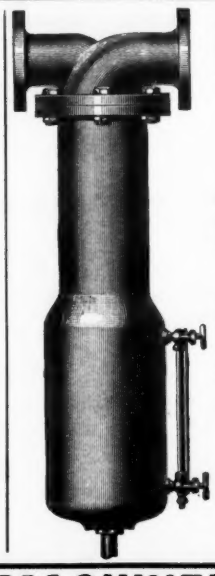

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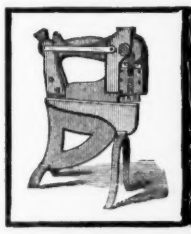

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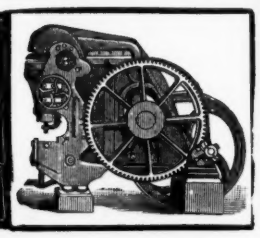

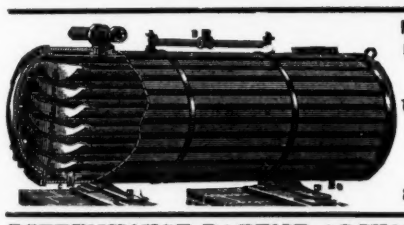

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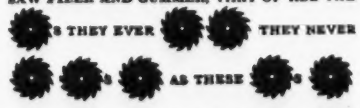

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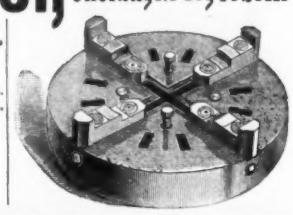

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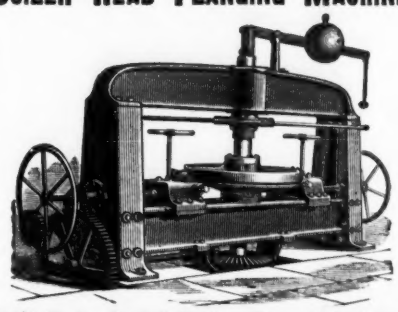

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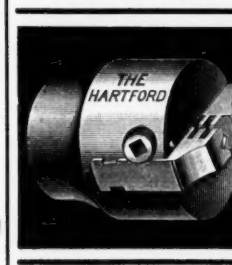

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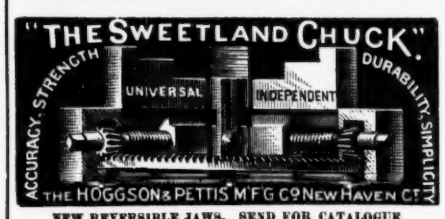

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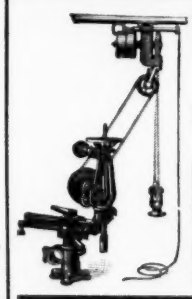

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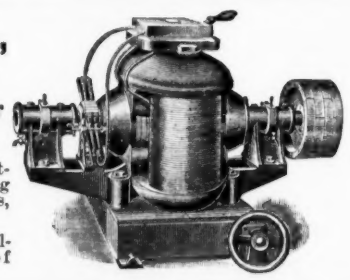

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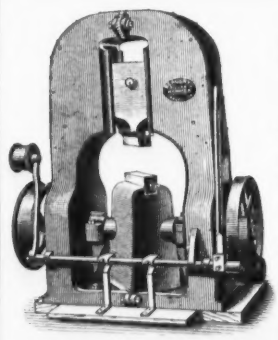

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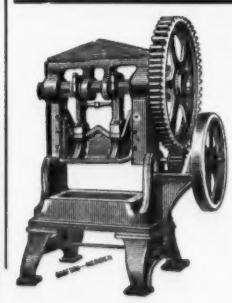

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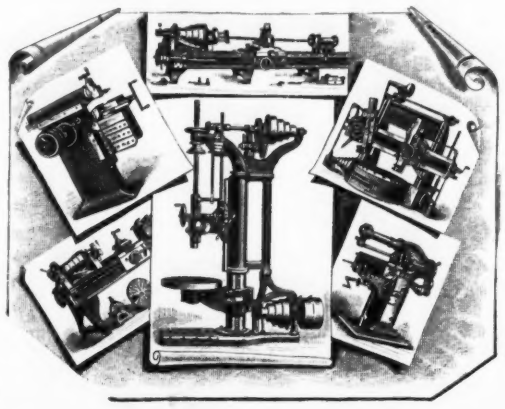

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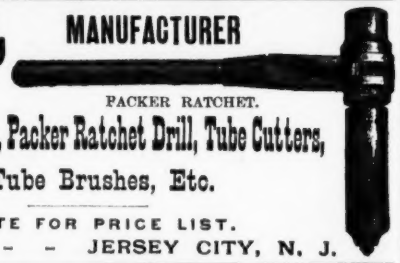

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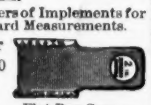

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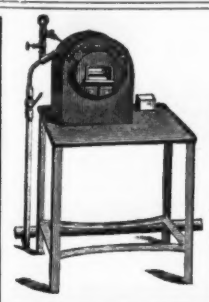

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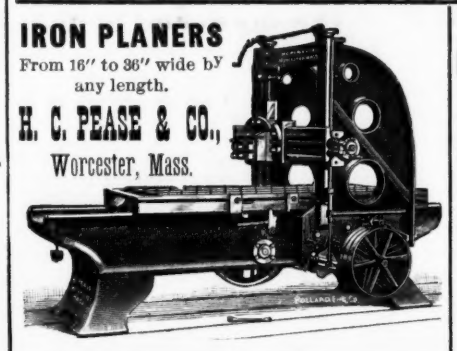

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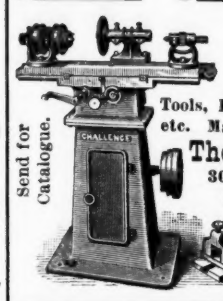

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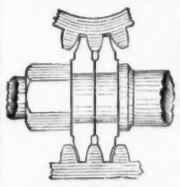

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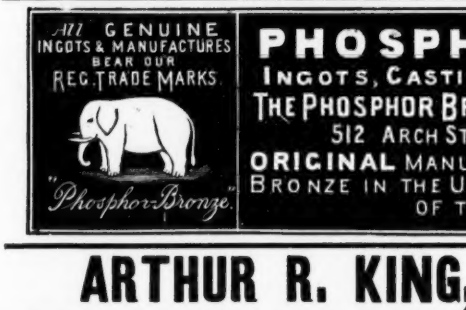

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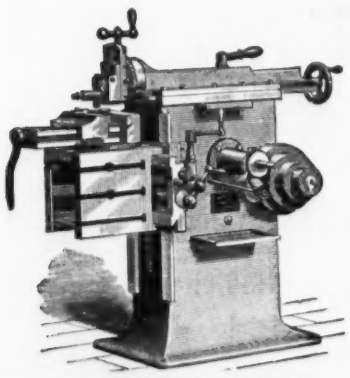

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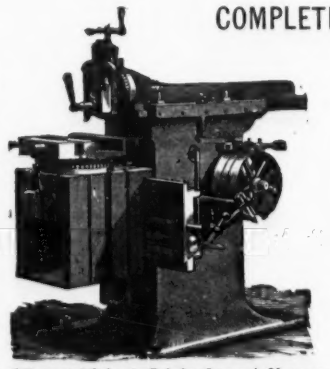

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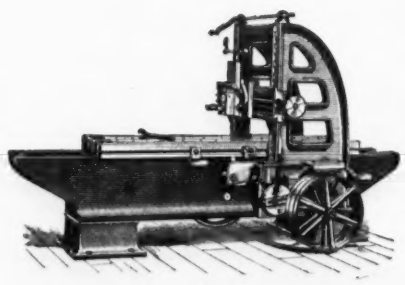

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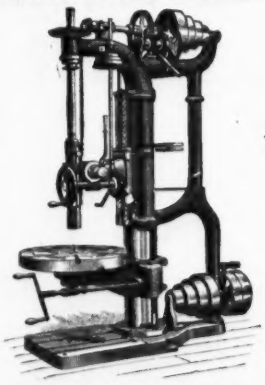

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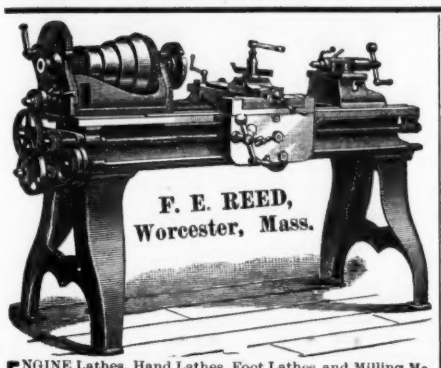

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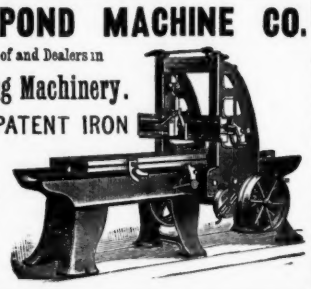

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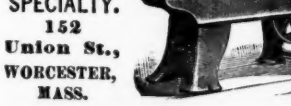

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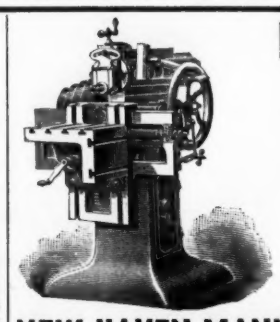

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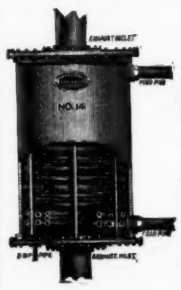

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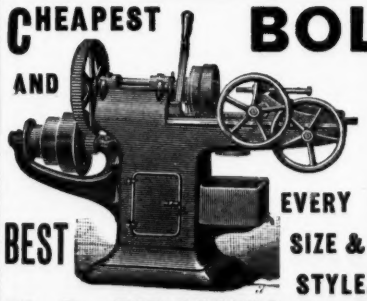

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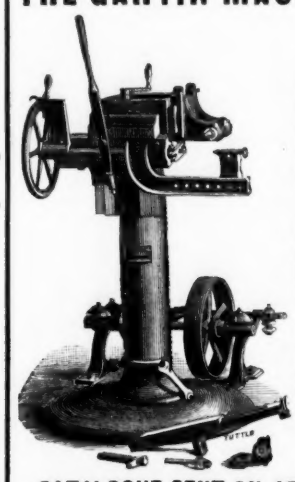

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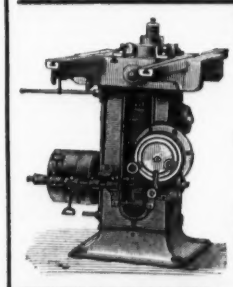

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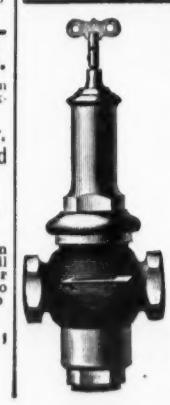

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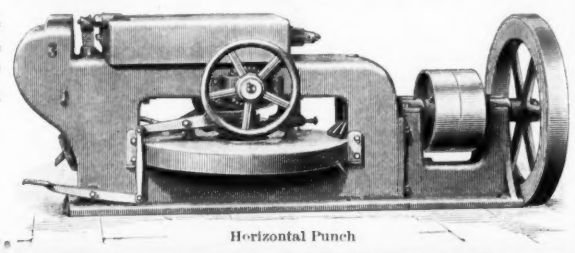
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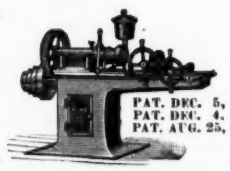
PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

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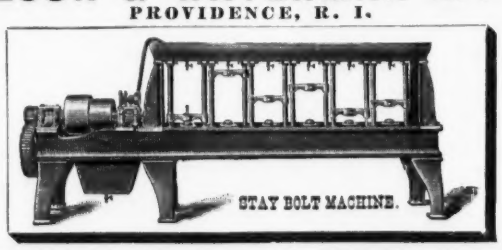
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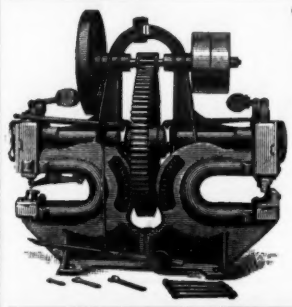
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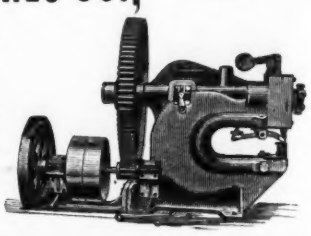

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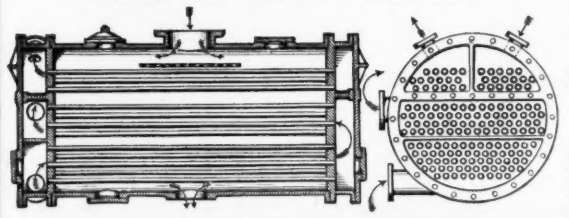
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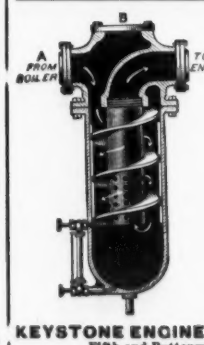

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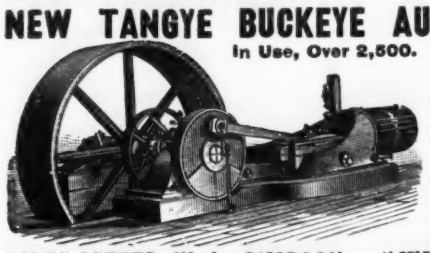

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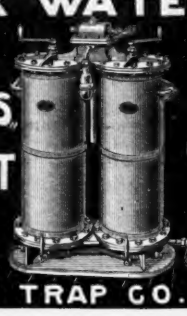

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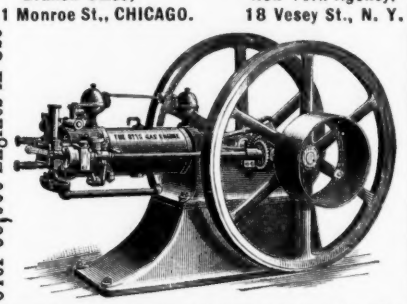

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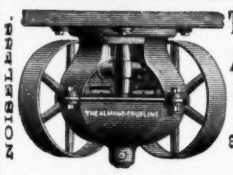

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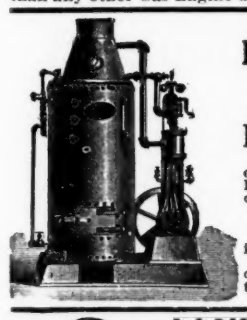

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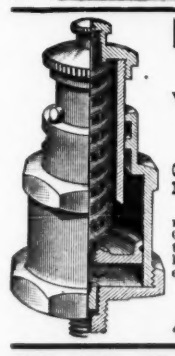

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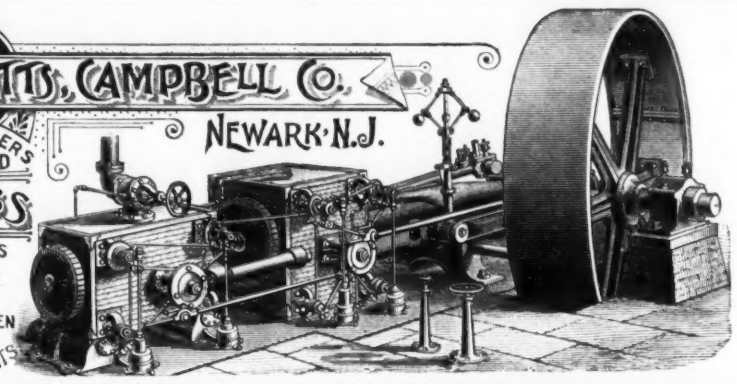

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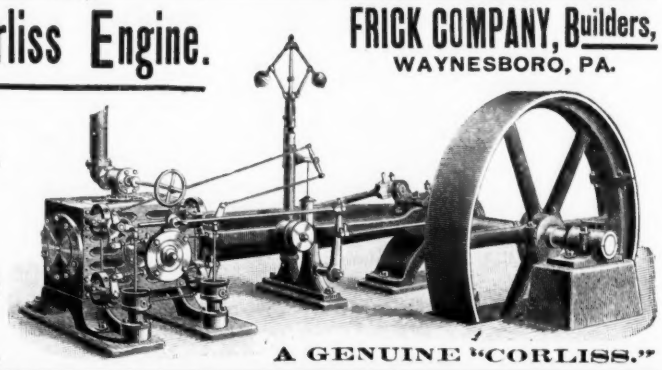

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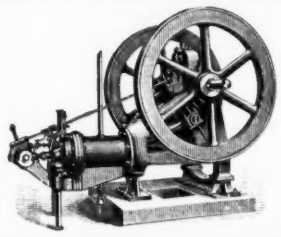

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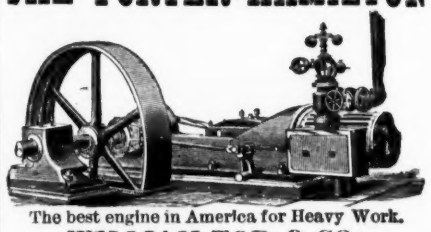

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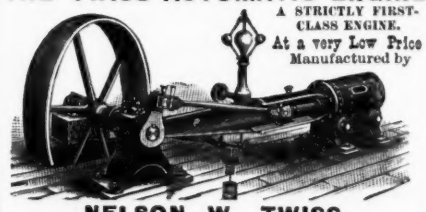

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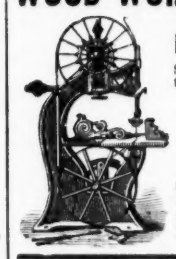

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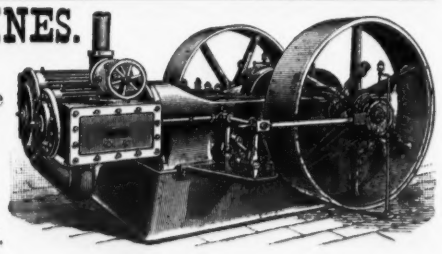

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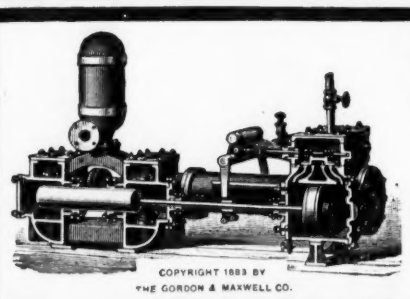

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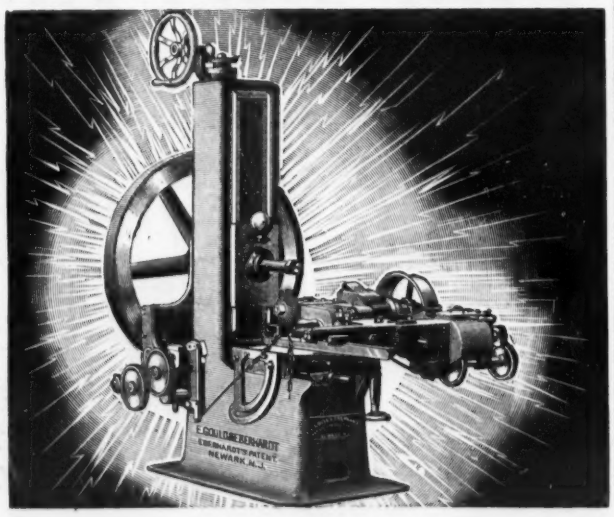

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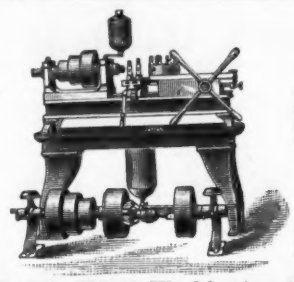

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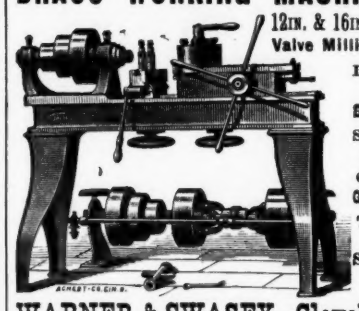

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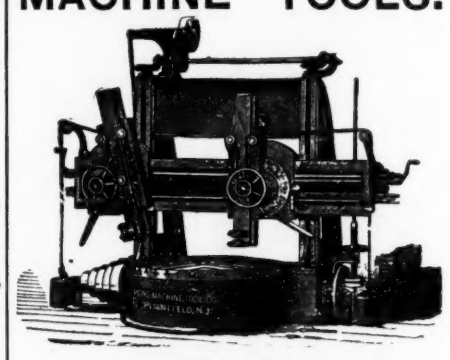

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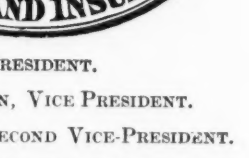

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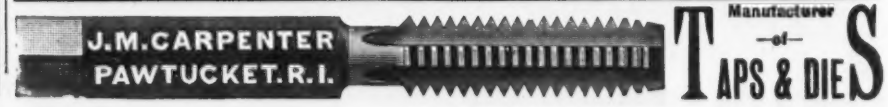

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